



TEST REPORT DIN VDE 0620-2-1:2013 Plugs and socket-outlets for household and similar purposes Part 2-1: General requirements on Plugs and portable socket-outlets	
Report reference No.....	70.410.16.104.04-00
Date of issue.....	2016-05-17
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Client.....	
Client number.....	
Address	
Contact person.....	
Standard	This TÜV SUD test report form is based on the following requirements: DIN VDE 0620-2-1:2013 in conjunction with DIN VDE 0620-1:2013
TRF originated by.....	TUV SUD Product Service GmbH, Mr.Yi ZHU
Copyright blank test report.....	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TÜV SUD Product Service GmbH. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
Scheme	<input checked="" type="checkbox"/> GS, <input type="checkbox"/> TÜV Mark, <input type="checkbox"/> EU-Directive, <input type="checkbox"/> without certification
Non-standard test method	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes, see details under Summary
National deviations	N/A
Number of pages (Report)	39
Number of pages (Attachments).....	N/A
Compiled by..... (+ signature)	Ying LIU 
Approved by..... (+ signature)	Yi ZHU 



Test sample.....	Adaptor	
Type of test object.....	Adaptor with SPD	
Trademark.....		
Model and/or type reference.....	FR101, FR102, FR103, FR104	
Rating(s).....	16A 250V~	
Manufacturer.....		
Manufacturer number.....		
Address.....		
Sub-contractors/ tests (clause).....	N/A	
Name.....	N/A	
Order description.....	<input checked="" type="checkbox"/>	Complete test according to TRF
	<input type="checkbox"/>	Partial test according to manufacturer's specifications
	<input type="checkbox"/>	Preliminary test
	<input type="checkbox"/>	Spot check
	<input type="checkbox"/>	
Date of order.....	2016-04-12	
Date of receipt of test item.....	2016-04-12	
Date(s) of performance of test.....	2016-04-12 to 2016-05-17	
Standard Sheet.....	DIN 49440 teil 1; DIN 49441 teil 1 Form R1	
Rated current (A).....	16A	
Rated voltage (V).....	250V	
Degree of protection against harmful ingress of water.....	<u>ordinary</u> / splash-proof (IPX4) / jet-proof (IPX5)	
Provision for earthing.....	without earthing contact / <u>with earthing contact</u>	
Method of connecting the cable.....	rewirable / <u>non-rewirable</u>	
Type of cable.....	N/A	
Nominal cross-sectional areas (mm ²).....	N/A	
Type of terminals.....	screw type / screwless (rigid) / <u>screwless (rigid and flexible)</u>	
Type of connections.....	<u>soldered</u> / <u>welded</u> / crimped / riveted	

Socket-outlets:	
Degree of protection against electric shock... :	<u>normal protection</u> / increased protection
Existence of enclosures	<u>enclosed</u>
Existence of shutters	without shutters / <u>with shutters</u>
Method of application / mounting of the socket-outlet	surface type / flush type / semi flush type / panel type / architrave type / portable type / table type (single/multiple) / floor recessed type / appliance type
Method of installation	design A / design B
Plugs:	
Class of equipment	Two pole with earth contact, German standard I
Attachments:	
General remarks:	
<p>"(see remark #)" refers to a remark appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a comma is used as the decimal separator. The test results presented in this report relate only to the object tested. This report shall not be reproduced except in full without the written approval of the testing laboratory.</p>	
<p>The following contents are included and as attachments of this test report:</p> <ul style="list-style-type: none"> • Test report DIN VDE 0620-2-1:2013 in conjunction with DIN VDE 0620-1:2013 • Test report EN 41003:2008 • Test report EN 61643-11:2012 • Photo documentation • Data form for electrical equipment and machinery 	

Summary of testing:

The test results comply with the requirements:

DIN VDE 0620-2-1:2013 in conjunction with DIN VDE 0620-1:2013;

Telecom ports integrated in portable socket-outlets is evaluated and complies with EN 41003:2008.

Surge-protective devices (SPD) is evaluated and comply with EN 61643-11:2012.

Appliances are evaluated and complied with the PAK/PAH requirements of AfPS GS 2014:01 PAK

Copy of marking plate:

Refer to the CDF

Picture of the product

See photo documentation

Purpose of the product

Adaptors for household use, with a schuko plug portion and a schuko socket-outlet portion, with SPD, with telecom ports.

Model difference:

FR101: with SPD, with a pair of TV coaxial connector, a pair of tel/fax/modem port(RJ11), a pair of network port(RJ45).

FR102: with SPD, with a pair of tel/fax/modem port(RJ11), a pair of network port(RJ45).

FR103: with SPD, with a pair of TV coaxial connector.

FR104: with SPD.

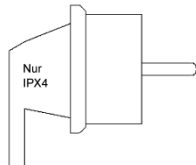
Possible test case verdicts:

- test case does not apply to the test object : N/A (not applicable / not included in the order)
- test object does meet the requirement..... : P (Pass)
- test object does not meet the requirement..... : F (Fail)

Possible suffixes to the verdicts:

- suffix for detailed information for the client..... : - C (Comment)
- suffix for important information for factory inspection... : - M (Manufacturing)

Clause	Requirement – Test	Measuring result – Remark	Verdict
5.7	Devices with crimp connections:		
	For additional tests on crimp connections see Appendices D and 12.4 Requirements on the manufacturer - Suitability of crimping tool on 50 samples - Routine test during production Picture documentation on devices with crimp connections see attachment		N/A
6.3	The degree of protection of plugs for devices with detachable cord must at a minimum conform to the degree of protection of the respective device, provided it is not regulated in the product standard for the device.		N/A
8	MARKING		
8.1	Connectors marked with:		
	- rated current (A)	16A	P
	- rated voltage (V)	250V	P
	- symbol for nature of supply	~	P
	(see section 5 GPSG) a. hints for a safe use b. manufacturer's or responsible vendor's name or trade mark in accordance with the GPSG on the product or packaging		P
	- type reference	See page 1	P
	- symbol for degree of protection (first digit)	IP2X	P
	- symbol for degree of protection (second digit)	IPX0	P
	Socket-outlets with screwless terminals marked with:		
	- the length of insulation to be removed		N/A
	- an indication of the suitability to accept rigid conductors only (if any)		N/A
8.2	Symbols used: as required in the standard		P
	Marking for the nature of supply placed next to the marking for rated current and rated voltage		P
8.3	VOID		
8.4	Plugs and portable socket-outlets: marking specified in 8.1, other than the type reference, easily discernible		P
	Plugs and portable socket-outlets for equipment of class II not marked with the symbol for class II construction		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Portable socket-outlets with IP-degree of protection IPX4, have to be marked with the new symbol 		N/A
8.5	Neutral terminals: N		N/A
	Earthing terminals: [earth symbol]		P
	Markings not placed on screws or other easily removable parts		P
	Terminals for conductors not forming part of the main function of the socket-outlet:		
	- clearly identified unless their purpose is self evident, or		N/A
	- indicated in a wiring diagram fixed to the accessory		N/A
	Identification of accessory terminals may be achieved by:		
	- their marking with graphical symbols according to IEC 147 or colours and/or alphanumeric system, or		P
	- their physical dimension or relative location		P
8.6	VOID		
8.7	VOID		
8.8	Marking durable and if possible not smaller than 3 mm,. Clearly readable without visual aids. Test: 15 s with water and 15 s with petroleum spirit		P
8.9	Portable multiple socket-outlets and adaptor must have the following warnings on the equipment or in the package		P
	For portable multiple socket outlet - Do not connect after each other (Nicht hintereinander stecken) - Do not cover when in use (Nicht abgedeckt betreiben)		N/A
	For portable multiple socket outlet with functional switch, additionally - To disconnect Voltage pull the plug (Spannungsfrei nur bei gezogenem Stecker)		N/A
	For adaptor - Do not connect after each other (Nicht hintereinander stecken)		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Portable multiple socket-outlets and extension cords shall be provided with the explanation of the using environment	nur zur Verwendung in trockenen Räumen	P
9	CHECKING OF DIMENSIONS		
9.1	Connectors and surface-type mounting boxes comply with the appropriate standard sheets DIN 49406 (alle Teile), DIN 49437, DIN 49440-1, DIN 49440-2, , DIN 49440-3, DIN 49440-4, DIN 49440-6, DIN 49441 (alle Teile), DIN 49442, DIN 49443, DIN 49445, DIN 49446, DIN 49447, DIN 49448, DIN 49464.	DIN 49440 teil 1 DIN 49441 teil 1 Form R1	P
	Insertion of plugs into fixed or portable socket-outlets ensured by their compliance with the relevant standard sheets		P
	Compliance checked by measurement and by means of gauges with manufacturing tolerances as shown in table 2		P
9.2	It shall not be possible to engage a plug with:		
	- a socket-outlet having a higher voltage rating or a lower current rating;		P
	- a socket-outlet with a different number of live poles (exception admitted provided that no dangerous situation can arise);		P
	- a socket-outlet with earthing contact (plug for class 0 equipment).		P
	Engagement of a plug for class 0 or class I equipment with a socket-outlet designed to accept plugs for class II equipment, not possible		P
	Impossibility of insertion checked by applying a gauge, for 1 min, with a force of:		
	- 150 N (rated current ≤ 16A);		P
	- 250 N (rated current > 16A)		N/A
	Connectors with elastomeric or thermoplastic material: test carried out at 35 °C ± 2 °C		P
9.3	Deviations from standard sheets made only if they provide technical advantage and do not affect the purpose and safety of Connectors complying with standard sheet		N/A
10	PROTECTION AGAINST ELECTRIC SHOCK		
10.1	Socket-outlets: live parts not accessible		P
	Live parts of plugs: not accessible when the plug is in partial or complete engagement with a socket-outlet		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Test with standard test finger shown in figure 2		P
	Connectors with elastomeric or thermoplastic material: additional test carried out at $35\text{ °C} \pm 2\text{ °C}$ with a straight unjointed test finger (75 N for 1 min)		P
	During the test: Connectors not deform and no live parts accessible		P
	Plugs and portable socket-outlets pressed with a force of 150 N for 5 min as shown in figure 22: specimens not show deformation		P
10.2	Accessible parts (with exception of small screws and the like for fixing bases and covers or cover plates): made of insulating material		P
	Cover or cover plates of plug and socket-outlets: made of metal if the requirements of 10.2.1 or 10.2.2 are fulfilled		N/A
10.2.1	Metal covers or cover plates protected by supplementary insulation made by insulating linings or insulating barriers		N/A
	Insulating linings or insulating barriers cannot be removed without being permanently damaged		N/A
	Insulating linings or insulating barriers cannot be replaced in an incorrect position and, if they are omitted, Connectors are rendered inoperable or manifestly incomplete		N/A
	There is no risk of accidental contact between live parts and metal covers or cover plates		N/A
10.2.2	Metal covers or cover plates automatically connected, through a low-resistance connection, to the earth during fixing		N/A
10.3	Connection between a pin of a plug and a live socket-contact of a socket-outlet not possible while any other pin is accessible	Construction proof	P
	Compliance checked by manual test and by means of gauges with tolerances as specified in 9.1		P
	Connectors with elastomeric or thermoplastic material: test carried out at $35\text{ °C} \pm 2\text{ °C}$		P
	Socket-outlets with enclosure or bodies of rubber or polyvinyl chloride: test carried out with a force of 75 N for 1 min		P
10.4	External parts of plugs and portable socket-outlets made of insulating material		P
	Overall dimensions of rings around pins not exceed 8 mm concentric with respect to the pin		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
10.5	Shuttered socket-outlets: live parts not accessible, without a plug in engagement, with the gauge shown in figure 4		P
	Live contacts automatically screened when the plug is withdrawn		P
	Means cannot easily be operated by anything other than a plug and not depend upon parts which are liable to be lost		P
	Gauge applied to the entry holes corresponding to live contacts with a force up to 1 N shall not touch live parts		P
	Connectors with elastomeric or thermoplastic material: test carried out at $35\text{ °C} \pm 2\text{ °C}$		P
	Shutters may not improperly hinder the plug from being inserted. The force to open the shutter may not exceed 30 N. The testing is done with gauges 19a or 19b. The gauge should be aligned in a movable fashion.		P
10.6	Earthing contacts of a socket-outlet designed that they cannot be deformed by the insertion of a plug		P
10.6.1	The socket-outlet is placed with the outlet contacts in vertical position. Gauge 14 inserted into the socket outlet with a force of 150 [+0/-5] N for 1 min. this test is conducted on new sample. After this test: socket-outlet still comply with the requirements of clause 9		P
10.6.2	Side PE contacts are loaded with a torque of 100 [+0/-5] Ncm for 1 min. With the device picture 43. After this tests probe 4 must be possible to insert. This test is conducted on new samples		P
10.7	Socket-outlet with increased protection: live parts not accessible		N/A
	Gauge of figure 4 applied with a force of 1 N on all accessible surfaces shall not touch live parts		N/A
	Connectors with elastomeric or thermoplastic material: test carried out at $35\text{ °C} \pm 2\text{ °C}$		N/A
11	PROVISION FOR EARTHING		
11.1	Earth connection made before the current-carrying contacts of the plug become live		P
	Current-carrying pins shall separate before the earth connection is broken		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
11.2	Earthing terminals of rewirable Connectors comply with clause 12		N/A
	Earthing terminals of the same size as the corresponding terminals for the supply conductors		N/A
	Earthing terminals of rewirable Connectors: internal		N/A
	Parts of earthing circuit in one piece or reliably connected by riveting, welding, or the like		P
11.3	VOID		
11.4	Socket-outlets, other than ordinary, with enclosure of insulating material and more than one cable inlet, provided with an internal earthing terminal for the continuity of the earthing circuit, unless		N/A
	earthing terminals allows the connection of an incoming and an outgoing earthing conductor together		N/A
11.5	Connection between earthing terminal and accessible metal parts: of low resistance		N/A
	Test:		
	Test current equal to 1,5 times the rated current or 25 A (A)		—
	Resistance not exceed 0,05 Ω (Ω)		N/A
12	TERMINALS		
	All the test on terminals, with the exception of the test of 12.3 11, made after the test of clause 16		P
12.1	General		
12.1.1	Rewirable plugs and portable socket-outlets provided with terminals with screw clamping	Non-rewirable	N/A
	Pre-soldered flexible conductors used: pre-soldered area outside the squeezed area of screw-type terminals		N/A
	Clamping means of terminals: not serve to fix any other components		N/A
12.1.2	Non-rewirable Connectors provided with soldered, welded, crimped or equally effective permanent connections	Welded, Soldered	P
	Screwed or snap-on connections not used		P
	Connections made by crimping a pre-soldered flexible conductor not permitted		P
12.2	Terminals with screw clamping for external copper conductors		N/A
12.2.1	Connectors provided with terminals which allows the proper connection of copper conductors as shows in table 3		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Rated current (A); Type of Connectors		—
	Type of conductor (rigid / flexible)		—
	Smallest / largest cross-sectional area (mm ²)		—
	Diameter of the largest conductor (mm)		—
	Figure of terminal		—
	Minimum diameter D (minimum dimensions) of conductor space: required (mm); measured (mm) .:		N/A
12.2.2	Terminals allow the conductor to be connected without special preparation		N/A
12.2.3	Terminals have adequate mechanical strength		N/A
	Screws and nut for clamping the conductors have metric ISO thread or a comparable thread		N/A
	Screws not of soft metal such as zinc or aluminium		N/A
12.2.4	Terminals resistant to corrosion		N/A
12.2.5	Screw-type terminals clamp the conductor(s) without undue damage		N/A
	Test with apparatus shown in figure 32:		
	- type of conductors	rigid solid / rigid stranded / flexible	—
	- number of conductors		—
	- smallest cross-sectional area (mm ²) (table 3); diameter of bushing hole (mm); height H (mm); mass (kg)		N/A
	- largest cross-sectional area (mm ²) (table 3); diameter of bushing hole (mm); height H (mm); mass (kg)		N/A
	- nominal diameter of thread (mm); torque according to table 6 (Nm)		—
	During the test: conductor not slip out, no break near clamping unit and no damage		N/A
12.2.6	Terminals clamp the conductor reliably between metal surfaces		N/A
	Pull test (1 min):		
	- type of conductors	rigid solid / rigid stranded / flexible	—
	- number of conductors		—
	- smallest cross-sectional area (mm ²) (table 3); pull (N)		N/A
	- largest cross-sectional area (mm ²) (table 3); pull (N)		N/A
	- torque (Nm) (2/3 table 6)		—

Clause	Requirement – Test	Measuring result – Remark	Verdict
	During the test: conductor not move noticeably		N/A
12.2.7	Terminals designed or placed that the conductor cannot slip out while the clamping screws or nuts are tightened		N/A
	- largest cross-sectional area (mm ²) (table 3)		—
	- number of wires and nominal diameter of wires (table 5):		N/A
	plugs and portable socket-outlets: flexible conductors		—
	- terminals intended for looping-in 2 or 3 conductors: permissible number of conductors		—
	- torque (Nm) (2/3 table 6)		—
	After the test: no wire of the conductor escaped outside the clamping unit		N/A
12.2.8	Terminals not work loose from their fixing to Connectors		N/A
	Torque test:		N/A
	- rigid solid copper conductor of the largest cross-sectional area (mm ²) (table 3)		—
	- torque (Nm) (table 6 or appropriate figures 34, 35, 36)		—
	Screws and nuts tightened and loosened 5 times. During the test: terminals not work loose and show no damage		N/A
12.2.9	Clamping screws or nuts of earthing terminals: adequately locked against accidental loosening, not possible to loosen them without the aid of a tool		N/A
12.2.10	Earthing terminals: no risk of corrosion		N/A
	Body of brass or other metal no less resistant to corrosion		N/A
	If the body is a part of a frame or enclosure of aluminium alloy, precautions shall be taken to aVOID the risk of corrosion		N/A
12.2.11	Pillar terminals: distance <i>g</i> no less than the value specified in figure 34: required (mm); measured (mm)		N/A
	Mantle terminals: distance <i>g</i> no less than the value specified in figure 37: required (mm); measured (mm)		N/A
12.3	VOID		
12.4	Special requirements on picture documentation		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	<p>Crimp connections</p> <p>Crimp connections of non-rewirable plugs and non-rewirable portable socket-outlets must exhibit sufficient electrical and mechanical properties. A picture documentation must be generated from 3 sides of at least 3 points of contact, consisting of side view, top view and perspective view. The values for crimp height, withdrawal force or voltage drop (upper and lower limit) must be determined and documented by the manufacturer; these will be the basis for the routine tests during production.</p>		N/A
13	VOID		
14	CONSTRUCTION OF PLUGS AND PORTABLE SOCKET-OUTLETS		
14.1	Non-rewirable plug or non-rewirable portable socket-outlet:		
	flexible cable cannot be separated from the accessory without making it permanently useless	Without cable	N/A
	Accessory cannot be opened by hand or by using a general purpose tool, for example a screwdriver used as such		P
14.2	Pins of plugs and portable socket-outlets: adequate mechanical strength	solid	P
	Test for pins not solid (made after clause 21): force of 100 N exerted on the pin for 1 min by means of a steel rod Ø 4,8 mm		
	During the application of the force: reduction of the dimension of the pin not exceed 0,15 mm		N/A
	After removal of the rod: dimensions of the pin not changed by more than 0,06 mm		N/A
14.3	Pins of plugs:		
	- locked against rotation		P
	- not removable without dismantling the plug		P
	- adequately fixed in the body of the plug when the plug is wired and assembled as in normal use		P
	Earthing or neutral pins or contacts of plugs: not possible to insert in an incorrect position		P
14.4	Earthing contacts and neutral contacts of portable socket-outlets:		
	- locked against rotation		P
	- removable only with the aid of a tool, after dismantling the socket-outlet		P
14.5	Socket-contact assemblies: sufficient resiliency		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Parts of contacts with the pin are:		
	- not from insulation material		P
	- in contact with pin at least in two opposite positions		P
14.6	Pins and socket-contacts: resistant to corrosion and abrasion		P
14.7	Enclosures of rewirable Connectors: completely enclose terminals and ends of flexible cable.		N/A
	Construction of rewirable Connectors:		N/A
	- conductors can be properly connected		N/A
	- cores not pressed against each other		N/A
	- cores of live conductor not in contact with accessible metal parts		N/A
	- core of earthing conductor not in contact with live parts		N/A
14.8	Rewirable Connectors: terminal screws or nuts cannot become loose and fall out of position and establish an electrical connection between live parts and earthing terminal or metal parts		N/A
14.9	Rewirable Connectors with earthing contact: ample space for slack of earthing (test)		N/A
	Non-rewirable non-moulded-on Connectors with earthing contact: current-carrying conductors stressed before the earthing conductor if the flexible cable slips in its anchorage		N/A
14.10	Terminals of rewirable Connectors and terminations of non-rewirable Connectors: located and shielded that loose wires not present a risk of electric shock		P
14.10.1	Rewirable Connectors: test with 6 mm free wire		
	free wire of a conductor connected to a live terminal not touch any accessible metal part or able to emerge from the enclosure		N/A
	free wire of a conductor connected to an earthing terminal not touch a live part		N/A
14.10.2	Non-rewirable, non-moulded-on Connectors: test with a free wire of length equivalent to the maximum designed stripping length declared by the manufacturer plus 2 mm		
	free wire of a conductor connected to a live termination not touch any accessible metal part or reduce creepage and clearance below 1,5 mm to the external surface		P
	free wire of a conductor connected to an earth termination not touch any live part		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
14.10.3	Non-rewirable, moulded-on Connectors:		
	Verification of means to prevent stray wires reducing the minimum distance through insulation to external accessible surface below 1,5 mm		N/A
14.11	Rewirable plugs and rewirable portable socket-outlets:		
	- clear how relief from strain and prevention of twisting is intended to be effected		N/A
	- cord anchorage, or at least part of it, integral with or permanently fixed to one of the component parts of the plug or portable socket-outlet		N/A
	- makeshift methods not used		N/A
	- cord anchorage suitable for the different types of flexible cable which may be connected; screws, if any: not serve to fix any other component		N/A
	- cord anchorages: of insulating material or provided with an insulating lining fixed to the metal parts		N/A
	- metal parts of cord anchorages, including clamping screws: insulated from the earthing circuit		N/A
14.12	Insulating parts which keep live parts in position: reliably fixed together; not possible to dismantle the accessory without the aid of a tool		P
14.13	Covers of portable socket-outlets: bushings for entry holes for the pins not removable from the outside or detachable inadvertently from the inside		N/A
14.14	Screws intended to allow access to interior of the accessory: captive		N/A
14.15	Engagement face of plugs: no projections		P
14.16	Engagement face of portable socket-outlets: no projection		P
14.17	Connectors other than ordinary: provided with gland(s) or the like	Without cable	N/A
	Plugs other than ordinary: adequately enclosed		N/A
	Portable socket-outlets other than ordinary: adequately enclosed without a plug in engagement		N/A
	Lid springs (if any): of corrosion resistant material (bronze or stainless steel)		N/A
14.18	Portable socket-outlets with means for permanent mounting shall be tested as fixed outlets with a current acc. to table 20, glow wire test 28.1.1 and additionally for strength to 24.1		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	No free openings between space intended for suspension means fixed to the wall and live parts		N/A
14.19	Combinations of plugs and socket-outlets with circuit-breakers or other protective devices comply with relevant standards, if any		P
14.20	Portable Connectors: not integral part of lampholders Adaptors without interposed auxiliaries (switches, regulators, timers etc.) shall comply with DIN 49437 Multiple outlets with earthing contact and with stiffly mounted plug are not allowed		P
14.21	Plugs for equipment of class II:		N/A
	- non-rewirable		N/A
	- if incorporated in a cord set: provided with a connector for equipment of class II		N/A
	- if incorporated in a cord extension set: provided with a portable socket-outlet for equipment of class II		N/A
14.22	Components (switches and fuses) incorporated in Connectors: comply with the relevant IEC standard	See CDF	P
14.23	Plug-in equipment: not cause overheating of the pins or impose undue strain		N/A
	Plugs with rating above 16 A and 250 V: not integral part of other equipment		N/A
	Tests for two-pole plugs, with or without earthing contact, with rating up to and including 16 A and 250 V (plug of equipment inserted into a fixed socket-outlet complying with this standard):		N/A
14.23.1	Socket-outlet connected to a supply voltage equal to 1,1 times the highest rated voltage of the equipment (V)		—
	Temperature rise of the pins after 1 h not exceed 45 K (K)		N/A
14.23.2	Additional torque applied to the socket-outlet to maintain the engagement face in the vertical plane not exceed 0,25 Nm (Nm)		N/A
14.24	Plugs: can easily withdrawn by hand from the relevant socket-outlet		P
	Gripping surfaces: so designed that the plug can be withdrawn without pull on the flexible cable		P
14.25	Membranes in inlet openings: meet the requirements of 13.23 and 13.24		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
14.26	Plugs and socket outlets on intermediate adaptors shall comply with DIN 49440 and 49441		P
	intermediate adaptors must be so constructed and the connection of the cord so manufactured that the efficacy of the protective measures is assured.		N/A
	One constructive unit may only accommodate one plug and one socket outlet.		P
	The cord shall be at least 1.4m long. Length...		N/A
	intermediate adaptors shall not impose undue strain on the socket outlet. (0,25Nm)		N/A
14.27	The length of the cord for table-top outlets shall be at least 1,4m. Length.....		N/A
	For cords in spiral form the length is measured when stretched under own weight.		N/A
14.28	Portable socket-outlets with self-closing lids for securing the protection degree higher or equal to IPX4 shall be constructed that the correct functioning of the self-closing lid is ensured during intended use. Compliance on portable socket-outlet with self-closing lid is checked by inspection and test according to 24.20		N/A
	In case of no-self-closing lids, the lid shall be fixed sufficiently to the portable socket-outlet. Compliance on portable socket-outlet with non-self-closing lid is checked by inspection and test according to 24.21		N/A
15	KEEP FREE		
16	RESISTANCE TO AGEING, TO HARMFUL INGRESS OF WATER AND TO HUMIDITY		
16.1	Resistance to ageing		
	Connectors shall be resistant to ageing		P
	Connectors subjected to a test in a heating cabinet at 70 °C ± 2 °C for seven days (168 h)		P
	After the tests, samples shall show:		
	- no crack visible with normal or corrected vision without additional magnification		P
	- no sticky or greasy material		P
	- no trace of cloth (forefinger pressed with 5 N)		P
	- no damage		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
16.2	Protecion by enclosure		
	Enclosure of Connectors shall provide a degree of protection against harmful ingress of water and solids in accordance with the IP classification	IP20	P
	Plugs and portable socket-outlets with glands or membrances are fitted with a cord according to 12.2.1. Glands are tightened with a torque 2/3 or the torque for the test in clause 24.6.		N/A
	Mounting screws for housings are tightened with 2/3 of the torque in table 6 of 12.2.8.		N/A
	Parts that can be removed without tools are removed.		N/A
	Plugs and portable socket-outlets tested on a plain, horizontal surface in a position as in normal use and fitted with flexible cables according to table 17 having the largest and smallest cross-sectional area given in table 3:		P
	- largest cross-sectional area (mm ²); type of cable (table 27)		—
	- smallest cross-sectional area (mm ²); type of cable (table 27)		—
	Mounting screws tightened with a torque equal to 2/3 of the torque given in table 6 (Nm)		—
	Glands tightened with a torque equal to 2/3 of the torque applied during the test of 24.6 (Nm)		—
	Portable socket-outlets tested without and with a plug in engagement		P
	Plugs are tested engaged with an socket-outlet of the same system and with the same degree of protection.		P
	Specimens withstand an electric strength test specified in 17.2 which is started immediately after the IP test		P
16.2.1	Protection against access to hazardous parts and ingress of solids	IP20	P
16.2.1.1	Protection against contact with hazardous parts		P
	Appropriate test performed as specified in EN 60529(VDE 0470)		P
16.2.1.2	Protection against ingress of solids		P
	Appropriate test performed as specified in EN 60529(VDE 0470)		P
	Test on plug and portable socket-outlets with IP5X: dust not penetrated in a quantity to interfere with satisfactory operation or to impair safety		N/A
	Drain holes keep closed		N/A
16.2.2	Protection against ingress of water		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Enclosure of plug and portable socket-outlets shall provide protections against ingress of water according to IP classification(test to EN 60529)	IPX0	N/A
	Immediately after this test the high voltage test 17.2 must be passed No water may penetrate in between the insulation and the strands		N/A
16.3	Resistance to humidity		
	Plug and portable socket-outlets proof against humidity which may occur in normal use		P
	Compliance checked by a humidity treatment carried out in a humidity cabinet containing air with relative humidity maintained between 91 % and 95 %		P
	Specimens kept in the cabinet for:		
	- two days (48 h) for ordinary Connectors		P
	- seven days (168 h) for Connectors other than ordinary		N/A
	After this treatment the specimens show no damage		P
17	INSULATION RESISTANCE AND ELECTRIC STRENGTH		
17.1.1	For socket-outlets: insulation resistance (500 V d.c. for 1 min):		
	a) between all poles connected together and the body, with a plug in engagement $\geq 5 \text{ M}\Omega$	$>6,5\text{M}\Omega$	P
	b) between each pole in turn and all others connected to the body, with a plug in engagement $\geq 5 \text{ M}\Omega$	$>6,5\text{M}\Omega$	P
	c) between any metal enclosures and metal foil in contact with the inner surface of its insulating linings, if any $\geq 5 \text{ M}\Omega$	$>6,5\text{M}\Omega$	P
	d) between any metal part of the cord anchorage, including clamping screws, and earthing terminal or earthing contact, if any, of portable socket-outlets $\geq 5 \text{ M}\Omega$	$\text{M}\Omega$	N/A
	e) between any metal part of the cord anchorage of portable socket-outlets and a metal rod of the maximum diameter of the flexible cable inserted in its place $\geq 5 \text{ M}\Omega$	$\text{M}\Omega$	N/A
17.1.2	For plugs: insulation resistance (500 V d.c. for 1 min):		
	a) between all poles connected together and the body $\geq 5 \text{ M}\Omega$	$>6,5 \text{ M}\Omega$	P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	b) between each pole in turn and all others connected to the body $\geq 5 \text{ M}\Omega$	$>6,5 \text{ M}\Omega$	P
	c) between any metal part of the cord anchorage, including clamping screws, and earthing terminal or earthing contact, if any $\geq 5 \text{ M}\Omega$	$\text{M}\Omega$	N/A
	d) between any metal part of the cord anchorage and a metal rod of the maximum diameter of the flexible cable inserted in its place $\geq 5 \text{ M}\Omega$	$\text{M}\Omega$	N/A
17.2	Socket-outlets: electric strength, test voltage (a.c., for 1 min):		
	a) test voltage (V)	4250 V / 2000 V	P
	b) test voltage (V)	4250 V / 2000 V	P
	c) test voltage (V)	4250 V / 2000 V	P
	d) test voltage (V)	1250 V / 2000 V	N/A
	e) test voltage (V)	1250 V / 2000 V	N/A
	Plugs: electric strength, test voltage (a.c., for 1 min):		
	a) test voltage (V)	4250 V / 2000 V	P
	b) test voltage (V)	4250 V / 2000 V	P
	c) test voltage (V)	1250 V / 2000 V	N/A
	d) test voltage (V)	1250 V / 2000 V	N/A
	During the test no flashover or breakdown		P
18	OPERATION OF EARTHING CONTACTS		
18.1	Earthing contacts provide adequate contact pressure and not deteriorate in normal use		P
	Compliance checked by the tests of clauses 19 and 21		P
	Force exerted measured in side earthing contacts not less than 5 N (CEE 7 clause 18)	$>5\text{N}$	P
18.2	Earthing contacts provide adequate contact pressure and not deteriorate in normal use.		P
	The test is conducted with the equipment in figure 15 at $35 \pm 2 \text{ C}$ with a force of 50 [N] applied in 168 [h]. The force must be applied where the contact takes place with the fully inserted plug.		P
	Compliance checked by measuring the change in the contact 30 seconds after the force is withdrawn. The change shall not deviate more than 1 [mm] from the measurement determined in clause 9.		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
19	TEMPERATURE RISE		
	Connectors and accessories have to be constructed that they can pass the following heating tests.		P
	Temperature rise on touchable metal parts not exceed 40 K and on touchable not metal covers not exceed 60 K	The maximum temperature rise on touchable metal covers is 16,4K <40K; The maximum temperature rise on touchable not metal covers is 21,2K <60K	P
19.1	KEEP FREE		
19.2	Portable outlets		N/A
	Portable outlets with cable are tested as delivered:		N/A
	- type of flexible cable; number of conductors and nominal cross-sectional area (mm ²).....:		—
	- rated current of accessory		—
	- nominal cross-sectional area (mm ²)		—
	- type of conductors		—
	Rewirable outlets without cable are to be fitted with polyvinyl chloride insulated conductors having a nominal cross-sectional area as show in table 15:		N/A
	Outlets are tested with a test plug according to figure 16		N/A
	Non-rewirable plugs of extension cords and multiple socket outlets are to be tested with a test current according to table 20 for non-rewirable sockets or rewirable connectors.		N/A
19.2.1	Portable outlets without accessories		N/A
	Outlets are tested for 1h with an AC current according to table 20		N/A
	The temperature rise of terminals and internal connections must not exceed 45 K.	Measured:	N/A
19.2.2	Portable outlets with accessories		N/A
	Outlets are tested as follows: Rated current for 1 h or until tripping of an internal protection device. The temperature rise of terminals and internal connections of accessories must not exceed the limits given in the related standards. The temperature rise of all other terminals and internal connections must not exceed 45 K		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	<p>After that outlets are tested with a test current according to table 20 for 1 h or until tripping of an internal protection device.</p> <p>If an internal protection device operates the test has to be repeated (for 1 h) with a current of 0.95 times the tripping current of the protection device.</p> <p>If the internal protection device is a fuse according to EN 60127-2 the test has to be repeated with 1,5 times the rated fuse current for 1 h for a rated fuse current up to 6.3 A 30 min for a rated fuse current above 6.3 A</p> <p>The temperature rise of terminals and internal connections must not exceed 70 K</p> <p>The temperature rise of the plug socket must not exceed 45 K</p>	<p>Measured:</p> <p>Measured:</p>	N/A
19.3	Plugs		N/A
	Plugs with cable are tested as delivered:		N/A
	- type of flexible cable; number of conductors and nominal cross-sectional area (mm ²).....:		—
	- rated current of accessory		—
	- nominal cross-sectional area (mm ²)		—
	- type of conductors	rigid solid / rigid stranded / flexible	—
	Rewirable outlets without cable are to be fitted with polyvinyl chloride insulated conductors having a nominal cross-sectional area as show in table 15:		N/A
	An appropriate (normal outlet) testing outlet with thermo couple on each pin and PE contact will be attached to the plug.		N/A
19.3.1	Plug without accessories		N/A
	Plugs are tested for 1h with an AC current according to table 20		N/A
	The temperature rise of terminals and internal connections must not exceed 45 K.	Measured:	N/A
19.3.2	Plug with accessories		N/A
	<p>Rewirable Plugs are tested as follows:</p> <p>Rated current for 1 h or until tripping of an internal protection device.</p> <p>The temperature rise of terminals and internal connections of accessories must not exceed the limits given in the related standards.</p> <p>The temperature rise of all other terminals and internal connections must not exceed 45 K</p>		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Non-Rewirable Plugs are tested as follows: Rated current for 1 h or until tripping of an internal protection device. The temperature rise of terminals and internal connections of accessories must not exceed the limits given in the related standards. The temperature rise of all other terminals and internal connections must not exceed 45 K		N/A
	After that plugs are tested with a test current according to table 20 for 1 h or until tripping of an internal protection device. If an internal protection device operates the test has to be repeated (for 1 h) with a current of 0.95 times the tripping current of the protection device. If the internal protection device is a fuse according to EN 60127-2 the test has to be repeated with 1,5 times the rated fuse current for 1 h for a rated fuse current up to 6.3 A 30 min for a rated fuse current above 6.3 A The temperature rise of terminals and internal connections must not exceed 70 K The temperature rise of the plug socket must not exceed 45 K	Measured: Measured:	N/A
19.4	Adaptor plug		P
	Adaptor-outlets are tested with a test plug according to figure 16		P
	For adaptor-plugs an appropriate (normal outlet) testing outlet with thermo couple on each pin and PE contact will be attached to the plug.		P
19.4.1	Adaptor without accessories (Adaptor according to DIN 49437)		N/A
	Adaptors are tested for 1h with an AC current according to table 20		N/A
	The temperature rise of terminals and internal connections must not exceed 45 K.	Measured:	N/A
19.4.2	Adaptor with accessories		P
	Adaptors with cable are tested as delivered:		P
	- type of flexible cable; number of conductors and nominal cross-sectional area (mm ²).....:		—
	- rated current of accessory	16 A	—
	- nominal cross-sectional area (mm ²)		—
	- type of conductors	rigid solid / rigid stranded / flexible	—
	Rewirable adaptors without cable are to be fitted with polyvinyl chloride insulated conductors having a nominal cross-sectional area as show in table 15:		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Adaptors are tested as follows: Rated current for 1 h or until tripping of an internal protection device. The temperature rise of terminals and internal connections of accessories must not exceed the limits given in the related standards. The temperature rise of all other terminals and internal connections must not exceed 45 K		P
	After that adaptors are tested with a test current according to table 20 for 1 h or until tripping of an internal protection device. If an internal protection device operates the test has to be repeated (for 1 h) with a current of 0.95 times the tripping current of the protection device. If the internal protection device is a fuse according to EN 60127-2 the test has to be repeated with 1,5 times the rated fuse current for 1 h for a rated fuse current up to 6.3 A 30 min for a rated fuse current above 6.3 A The temperature rise of terminals and internal connections must not exceed 70 K The temperature rise of the plug socket must not exceed 45 K	Test current: 20A Measured: The maximum temperature rise of PCB terminals is 43,9K <70K The maximum temperature rise of L/N terminal is 33,7K <45K; The maximum temperature rise of Earthing terminal is 41,1K < 45K;	P
19.5	Plug-in devices		N/A
	Plug-in devices are tested according to the related product standard. For testing of the plug see 14.23.		N/A
20	BREAKING CAPACITY		
	Connectors shall have adequate breaking capacity		P
	Compliance checked by testing:		
	- socket-outlets;		P
	- plugs with pins which are not solid	Plug is approved	N/A
	Test conditions:		
	- 100 strokes; rate of operation	30 strokes per minute	—
	- test voltage (1,1 Vn)	275V	—
	- test current (1,25 In) (power factor 0,6)	20A (for 16A socket) 3,125A (for 2,5A socket)	—
	Multiple socket-outlets: test carried out on one socket-outlet of each type and current rating		N/A
	During the test: no sustained arcing occur		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	After the test:		
	- specimens show no damage impairing their further use;		P
	- entry holes for the pins not show any damage which may impair the safety		P
21	NORMAL OPERATION		
	Connectors shall withstand without excessive wear or other harmful effect, the mechanical, electrical and thermal stresses occurring in normal use		P
	Compliance for socket-outlets as well as plugs with resilient earthing contacts or non solid pins is checked by testing, see figure 17.		
	- socket-outlets;		P
	- plugs with resilient earthing socket-contacts;		N/A
	- plugs with pins which are not solid		N/A
	Test performed on:		
	- complete shuttered socket-outlets		P
	- specimens prepared by the manufacturer without shutters (with current flowing). Number of strokes:		N/A
	- specimens with shutters (without current flowing)		N/A
	- complete shuttered socket-outlets with operations made by hand as in normal use		N/A
	Test conditions:		
	- 10000 strokes; rate of operation	30 strokes per minute	—
	- test voltage Vn (V)	250V	—
	- test current (as specified in table 20) (A) (power factor 0,8)	16A (for 16A socket) 6A (for 2,5A socket)	—
	Test current passed:		
	- during each insertion and withdrawal of the plug (In ≤ 16A)		P
	- during alternate insertion and withdrawal, the other insertion and withdrawal being made without current flowing (In > 16A)		N/A
	Multiple socket-outlets: test carried out on one socket-outlet of each type and current rating		N/A
	During the test: no sustained arcing occur		P
	After the test the specimens shall not show:		
	- wear impairing their further use;		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	- deterioration of enclosures, insulating lining or barriers;		P
	- damage to the entry holes for the pins, that might impair proper working;		P
	- loosening of electrical or mechanical connections;		P
	- seepage of sealing compound		N/A
	Shuttered socket-outlets: the following gauges not touch live parts when they remain under the relevant forces:		
	- gauges of figure 15 applied with a force up to 20 N		P
	- steel gauge of figure 13 applied with a force up to 1 N		P
	Temperature-rise test (requirements of clause 19):		
	Test current as required for the normal operation test, given in table 20, passed for 1 h (A)		—
	Temperature rise of terminals not exceed 45 K (K)	The maximum temperature rise of terminal is 37,7K <45K	P
	Separate tests made passing the current through:		
	- the neutral contact, if any, and the adjacent phase contact (K)		N/A
	- the earthing contact, if any, and the nearest phase contact (K)	The maximum temperature rise of Earthing terminal is 37,9K <45K	P
	Socket-outlets: electric strength (sub-clause 17.2), test voltage (a.c., for 1 min):		
	a) test voltage (V).....	4000 V / 1500 V	P
	b) test voltage (V).....	4000 V / 1500 V	P
	c) test voltage (V).....	1000 V / 1500 V	N/A
	d) test voltage (V).....	1000 V / 1500 V	N/A
	e) test voltage (V).....	1000 V / 1500 V	N/A
	Plugs: electric strength (sub-clause 17.2), test voltage (a.c., for 1 min):		
	a) test voltage (V).....	4000 V / 1500 V	P
	b) test voltage (V).....	4000 V / 1500 V	P
	c) test voltage (V).....	1000 V / 1500 V	N/A
	d) test voltage (V).....	1000 V / 1500 V	N/A
	During the test: no flashover or breakdown		P
	Pins of plugs and portable socket-outlets: test according to 14.2		N/A
	Force exerted measured in side earthing contacts not less than 60 % or 5 N (CEE 7 clause 18)		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	The force to open the shutter may not exceed 50 N, as specified in the normal operation test. The test is done with gauges 19a or 19b.		P
22	FORCE NECESSARY TO WITHDRAW THE PLUG		
	Construction of accessory shall allow the easy insertion and withdrawal of the plug, and prevent the plug from working out of the socket-outlet in normal use		P
	Rated current (A)	16A	P
	Number of poles	2P+E	P
22.1	Verification of the maximum withdrawal force		P
22.1.1	Test for Socket outlet(multi-pin gauge)		P
	- Maximum withdrawal force (N)	54 N/ 40N	—
	The plug not remain in the socket-outlet		P
22.1.2	Test for plugs with spring-loaded earth contact arrangements		N/A
	The test probe gauge, represented in gauge 16e, is used for the spring-loaded earth contact arrangement when the plug is held vertically and the gauge hangs down. The test probe gauge is made of hardened steel with a surface roughness between 0.6 µm and 0,8 µm over its usable length.		N/A
22.2	Verification of the minimum withdrawal force (single-pin gauge)		P
	- Minimum withdrawal force (N)	2 N/ 2N	—
	The plug not fall from each individual contact-assembly within 30 s		P
23	FLEXIBLE CABLES AND THEIR CONNECTION		
23.1	Rewirable plugs and rewirable portable socket-outlets provided with a cord anchorage such that the conductors at the terminals are relieved from strain and twisting and that their covering is protected from abrasion		N/A
	Sheath of flexible cable clamped within the cord anchorage		N/A
	Non-rewirable plugs and non-rewirable portable socket-outlets so designed that the cord is kept in position and the connections are relieved from strain and twisting.		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Sheath of flexible cable clamped within the connector.		N/A
23.2	Pull and torque test		
	The accessory is conditioned at 45 ⁰ C for 1h. Directly there after (while hot) a pull test is conducted with 50N for 30s, The anchorage shall remain functional but displacement of the cord may not exceed 2mm. Thereafter the samples are cooled down to ambient temperature for the further tests below		N/A
	Non-rewirable accessories:		
	- rating of accessory		—
	- type of flexible cable; number of conductors and nominal cross-sectional area (mm ²)		—
	- pull (100 times) (N)		N/A
	- torque (1 min) as specified in table 18 (Nm)		N/A
	After the test:		
	Displacement ≤ 2 mm		N/A
	No break in the electrical connections		N/A
	Rewirable accessories:		
	- rating of accessory		—
	- clamping screws, if any, tightened with a torque equal to 2/3 of that specified in 12.2.8 (Nm)		—
	- type of flexible cable; number of conductors and smallest nominal cross-sectional area (mm ²) as show in table 17		—
	- pull (100 times) (N)		—
	- torque (1 min) as specified in table 18 (Nm)		—
	After the test:		
	Displacement ≤ 2 mm		N/A
	End of conductors not have moved noticeably in the terminals		N/A
	- type of flexible cable; number of conductors and largest nominal cross-sectional area (mm ²) as show in table 17		—
	- pull (100 times) (N)		—
	- torque (1 min) as specified in table 18 (Nm)		—
	After the test:		
	Displacement ≤ 2 mm		N/A
	End of conductors not have moved noticeably in the terminals		N/A
	Rewirable accessories having rated current up to and including 16 A:		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Suitable for fitting with the appropriate cable as shown in table 19		N/A
	Type of flexible cable; number of conductors and nominal cross-sectional area (mm ²).....:		—
23.3	Non-rewirable plugs and portable socket-outlets shall be provided with a flexible cable complying with DIN VDE 0281 or DIN VDE 0282. Cross sectional area see table 20. Non-rewirable plugs may have other types or cord if permitted by other German standards A cable equipped with rewirable plug or portable socket outlet shall be of the same quality.		N/A
	Flexible cables have the same number of conductors as there are poles in the plug or socket-outlet		N/A
	Conductor connected to the earthing contact: identified by the colour combination green/yellow		N/A
	Non-rewirable plugs rated 16A/250V are tested: 1mm ² and 1.5mm ² at 16A/20A		N/A
	Extension cords and multiple connectors (table-type socket-outlets) without built-in safety device and its individual components must be designed for a rated current of 16 amps. A reduced cross-section below 1.5 mm ² up to and including 1.0 mm ² of the cable is acceptable only when a fuse or protection unit is installed that is related to the rated current of the cable. Extension cords and multiple connectors with cable and plug (table-type socket-outlet) are tested in assembled condition as one unit.		N/A
23.4	Plugs and portable socket-outlets with cord connected: designed that the flexible cable is protected against excessive bending		N/A
	Guards shall be of insulating material and fixed in reliable manner		N/A
	Flexing test (10.000 flexings):		
	- type of flexible cable and nominal cross-sectional area (mm ²)		—
	- test current (A)		—
	- mass (N)		—
	During the test: no interruption of the test current and no short-circuit between conductors		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Voltage drop test: test current (A); voltage drop (≤ 10 mV)		N/A
	After the test: guard no separated from the body, insulation shows no sign of abrasion or wear, broken strands become no accessible		N/A
24	MECHANICAL STRENGTH		
	Connectors and screwed glands have adequate mechanical strength		P
24.1	Portable multiple socket-outlets: impact test (apparatus shown in fig. 22, 23, 24 and 25)		N/A
	After the test: no damage, live parts no become accessible		N/A
24.2	Portable single socket-outlets and plugs: tumbling barrel test; number of falls	4000 / 500 / 400	P
	Terminal screws or nuts tightened with a torque equal to 2/3 of that specified in 12.2.8 (Nm)		—
	After the test:		
	No part become detached or loosened;		P
	Pins no become so deformed that the plug cannot be introduced into a socket-outlet and also fails to comply with the requirements of 9.1 and 10.3;		P
	Pins no turn when a torque of 0,4 Nm is applied for 1 min in each direction		P
	Socket-outlets with shutters shall be tested again with the shutter test in Clause 21		P
24.3	VOID		
24.4	Portable single socket-outlets, multiple socket-outlets and plugs (elastomeric or thermoplastic material): impact test, weight 1000 g, height 100 mm (apparatus shown in fig. 21)		P
	Specimens placed in a refrigerator at -15 °C \pm 2 °C for at least 16 h		P
	After the test: no damage		P
24.5	Portable single socket-outlets and plugs (elastomeric or thermoplastic material): compression test, 300 N for 1 min, position a) and b) (apparatus shown in fig. 22)		P
	After the test: no damage		P
24.6	VOID		
24.7	Plug pins provided with insulating sleeves: 20000 movements, 4 N (apparatus shown in fig. 23)		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	After the test: no damage of pins, insulating sleeve not have punctured or rucked up		N/A
24.8	Shuttered socket-outlets: mechanical test carried out on specimens submitted to the normal operation test according to clause 21		
	Force applied for 1 min against the shutter of an entry hole by means of one pin	40 N / 75 N	—
	Pin not come in contact with live parts		P
	After the test: no damage		P
24.9	Multiple portable socket-outlet: mechanical test		
	Rewirable multiple socket-outlets: flexible cable of the smallest cross-sectional area specified in table 3		—
	8 falls on concrete floor with the specimens arranged as shown in figure 24		N/A
	After the test: no damage, no part have become detached or loosened		N/A
	Connectors other than ordinary submitted again to the test as specified in 16.2		N/A
	Socket-outlets with shutters shall be tested again with the shutter test in Clause 21		N/A
24.10	Plugs: pull test to verify the fixation of pins in the body of the plug (new specimens)		
	Maximum withdrawal force (table 16) applied for 1 min on each pin in turn, after the specimen has been placed at 70 °C for 1 h	54 N	—
	After the test: displacement of pins in the body of the plug ≤ 1 mm	0,3 mm	P
24.11	Barriers of portable socket-outlets having means for suspension on a wall:		
	Force applied for 10 s against the barrier by means of a cylindrical steel rod (1,5 times the maximum plug withdrawal force specified in table 16) (N)	N	—
	Rod not pierce the barrier		N/A
24.12	Portable socket-outlets having means for suspension on a wall (pull test):		
	Pull applied to the supply flexible cable for 10 s (force prescribed in 23.2 for checking the flexible cable anchorage) (N)	60 N	—
	During the test: no break of the means for suspension on a wall		N/A
24.13	Portable socket-outlets having means for suspension on a wall (pull test):		

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Pull applied to the engagement face of the socket-outlet for 10 s (maximum withdrawal force specified, for the corresponding plug, in table 16) (N)	54N	—
	During the test: no break of the means for suspension on a wall		N/A
24.14	VOID		
24.15	VOID		
24.16	VOID		
24.17	VOID		—
24.18	VOID		—
24.19	<p>on socket-outlets with shroud</p> <p>The shroud of a socket-outlet is subjected to a compression test at an ambient temperature of 25 °C ± 5°C with the fixture shown in Figure 37b</p> <p>The force applied by flanges is 20N +/- 2N</p> <p>After 1 min and still under force the dimensions still have to be in line with the standard sheets.</p> <p>The test will be repeated after a 90° rotation.</p>		N/A
24.20	<p>on socket-outlets with hinged lid</p> <p>In order to secure a degree of protection greater or equal to IP 44 for socket-outlets with hinged lids the hinged lid is subjected to a motion test.</p> <p>After successful assembly, same as for intended use, the hinged lid is opened 5,000 times to a minimum of 5° before contact point. Any springs that may be present or other devices to close the lid may not get lost or rendered useless.</p>		N/A
24.21	For socket-outlets with hinged lid, and to test the captivity of the lid, the hinged lid is subjected to a tensile test for 30 sec. in the most unfavorable direction, without jerking, using a force of 50 N. The lid may not loosen and/or break away.		N/A
25	RESISTANCE TO HEAT		
25.1	Specimens kept in heating cabinet 100 °C for 1 h		
	During the test: no change impairing their further use and sealing compound, if any, not flow		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	After the test: markings still legible		P
25.2	Parts of insulating material of portable accessories necessary to retain current-carrying parts and parts of the earthing circuit in position, and parts of the front surface zone of 2 mm width surrounding the phase and neutral pin entry holes: ball-pressure test (1 h, 125 °C)		
	After the test: diameter of impression ≤ 2 mm	1,1mm	P
25.3	For parts not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though in contact with them: ball-pressure test (1 h)		
	Test temperature (°C)	70 °C	P
	After the test: diameter of impression ≤ 2 mm	1,0 mm	P
25.4	Portable Connectors: compression test (20 N, 1 h, 80 °C) by means of the apparatus shown in figure 28		
	After the test: no damage		P
26	SCREWS, CURRENT-CARRYING PARTS AND CONNECTIONS		
26.1	Connections withstand mechanical stresses		P
	Thread-forming or thread-cutting screws used only if supplied together with the piece in which they are intended to be inserted		N/A
	Thread-cutting screws intended to be used during installation: captive		N/A
	Screws and nuts which transmit contact pressure: in engagement with a metal thread		N/A
	Test:		
	- 10 times for screws in engagement with a thread of insulating material and for screws of insulating material		N/A
	- 5 times for all other cases		N/A
	- terminals: screw diameter (mm); torque (Nm); times		—
	- earthing terminals: screw diameter (mm); torque (Nm); times		—
	- assembly screws: screw diameter (mm); torque (Nm); times		—
	- cord anchorage: screw diameter (mm); torque (Nm); times		—
	- other screws or nuts: diameter (mm); torque (Nm); times		—
	During the test: no damage impairing the further use of the screwed connectons		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
26.2	Screws in engagement with a thread of insulating material: correct introduction into the screw hole or nut ensured		N/A
26.3	Contact pressure: not transmitted through insulating material other than ceramic, pure mica or other material no less suitable unless there is sufficient resiliency in metallic parts		P
	Connections made by insulation piercing of tinsel cord reliable		N/A
26.4	Screws and rivets locked against loosening and/or turning		N/A
26.5	Current-carrying parts of metal having mechanical strength, electrical conductivity and resistance to corrosion adequate:		
	- copper;		N/A
	- alloy with at least 58 % copper for parts made from cold-rolled sheet or with at least 50 % copper for other parts;	≥ 59%	P
	- stainless steel with at least 13 % chromium and not more than 0,09 % carbon		N/A
	- steel with electroplated coating of zinc (ISO 2081), with thickness of at least:		
	5 µm, service condition ISO no. 1, for ordinary equipment		N/A
	12 µm, service condition ISO no. 2, for splash-proof equipment		N/A
	25 µm, service condition ISO no. 3, for jet-proof equipment		N/A
	- steel with electroplated coating of nickel and chromium (ISO 1456), with thickness of at least:		
	20 µm, service condition ISO no. 2, for ordinary equipment		N/A
	30 µm, service condition ISO no. 3, for splash-proof equipment		N/A
	40 µm, service condition ISO no. 4, for jet-proof equipment		N/A
	- steel with electroplated coating of tin (ISO 2093), with thickness of at least:		
	12 µm, service condition ISO no. 2, for ordinary equipment		N/A
	20 µm, service condition ISO no. 3, for splash-proof equipment		N/A
	30 µm, service condition ISO no. 4, for jet-proof equipment		N/A
	Current-carrying parts subjected to mechanical wear: not of steel with electroplated coating		P

Clause	Requirement – Test	Measuring result – Remark	Verdict
	Metals having a great difference of electrochemical potential: not used in contact with each other		N/A
26.6	Contacts subjected to a sliding action: of metal resistant to corrosion		N/A
26.7	Thread-forming screws and thread-cutting screws not used for the connection of current-carrying parts		P
	Thread-forming screws and thread-cutting screws used to provide earthing connection: not necessary to disturb the connection and at least two screws are used for each connection		N/A
26.8	If other than screw-type or screwless terminals used for internal connections in plugs and portable socket-outlets, these connections shall be soldered, welded, crimped or equally effective permanent connections.		P
	Screwless terminations, similar like insulating piercing terminations, shall only be used for uninsulated rigid conductors, compliance is checked by the tests according to 12.3 as far as applicable.		N/A
	Screw-type terminals shall not be used for internal connections in non-rewirable portable accessories, Compliance is checked by inspection.		P
27	CREEPAGE DISTANCES, CLEARANCES AND DISTANCES THROUGH SEALING COMPOUND		
27.1	Creepage distances, clearances and distances through sealing compound no less than the values shown in table 23		P
	Creepage distances (cr):		
	1) between live parts of different polarity $\geq 4(3)$ mm :	>3,0 (measured by gauge)	P
	2) between live parts and:		
	- accessible insulating and earthed metal parts ≥ 3 mm :	>3,0 (measured by gauge)	P
	- parts of earthing circuit ≥ 3 mm :	>3,0 (measured by gauge)	P
	- external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit ≥ 3 mm :	>3,0 (measured by gauge)	P
	3) between pins of plugs and metal parts connected to them, when fully engaged, and a socket-outlet of the same system having accessible unearthed metal parts $\geq 6(4,5)$ mm :		N/A


Clause	Requirement – Test	Measuring result – Remark	Verdict
	4) between the accessible unearthed metal parts of a socket-outlet and a fully engaged plug of the same system having pins and metal parts connected to them $\geq 6(4,5)$ mm		N/A
	5) between live parts of a socket-outlet (without a plug) and its accessible unearthed metal parts $\geq 6(4,5)$ mm		N/A
	Clearances (cl):		
	6) between live parts of different polarity ≥ 3 mm ...	>3,0 (measured by gauge)	P
	7) between live parts and:		
	- accessible insulating and earthed metal parts not mentioned under 8 ≥ 3 mm	>3,0 (measured by gauge)	P
	- parts of earthing circuit ≥ 3 mm	>3,0 (measured by gauge)	P
	- external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit ≥ 3 mm	>3,0 (measured by gauge)	P
	8) between live parts and:		
	- accessible unearthed or functional earthed metal parts of plug and portable socket-outlets $\geq 6(4,5)$ mm		N/A
	9) keep free		
	10) keep free		
	Distance through insulating sealing compound:		N/A
	11) Between live parts of a portable socket-outlet(without plug) or of a plug and their accessible metal parts which are not connected to the earthing circuit $\geq 6(4,5)$ mm		N/A
	12) keep free		
	13) keep free		
	Distance through insulation		N/A
	14) Between accessible surface and live parts of non-rewirable, moulded-on plugs and portable socket-outlets $\geq 1,5$ mm		N/A
28	RESISTANCE OF INSULATING MATERIAL TO ABNORMAL HEAT, TO FIRE AND TO TRACKING		
28.1	Resistance to abnormal heat and to fire		
28.1.1	Glow-wire test		
	For parts of portable Connectors necessary to retain current-carrying parts and parts of the earthing circuit in position: test temperature 750 °C Note 5: The outer material by moulded plugs is totally removed when testing the supporting parts		

Clause	Requirement – Test	Measuring result – Remark	Verdict
	No visible flame and no sustained glowing		P
	Flame and glowing extinguish within 30 s		P
	No ignition of the tissue paper		P
	For parts not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though in contact with them: test temperature 650 °C		
	No visible flame and no sustained glowing		P
	Flame and glowing extinguish within 30 s		P
	No ignition of the tissue paper		P
28.1.2	Plugs with pins provided with insulating sleeves:		
	Test temperature maintained for 3 h by means of the apparatus shown in figure 26	120 °C / 180 °C	—
	Impact test according to sub-clause 30.4 (mass 100 g, height 100 mm, 4 impacts): no cracks of the insulating sleeves		N/A
28.2	Resistance to tracking		
	Parts of insulating material retaining live parts in position of Connectors other than ordinary: test voltage 175 V, 50 drops, solution A of IEC 112		N/A
	No flashover or breakdown		N/A
29	RESISTANCE TO RUSTING		
	Ferrous parts protected against rusting	No ferrous parts	N/A
	No signs of rust after 10 min in carbon tetrachloride, trichloroethane or equivalent degreasing agent, 10 min 10 % solution of ammonium chloride, 10 min in a box with air saturated with moisture and 10 min at 100 °C		N/A
30	ADDITIONAL TESTS ON PINS PROVIDED WITH INSULATING SLEEVES		
30.1	Pressure test at high temperature		N/A
	Apparatus shown in figure 29, with the test specimen in position, maintained for 2 h at 200 °C. Force applied through the blade: 2,5 N		N/A
	Thickness of insulation measured: before the test (mm); after the test (mm)		—
	Thickness within the area of impression \geq 50 % of the thickness measured before the test: percent value (%)		N/A
30.2	Static damp heat test		N/A
	Set of 3 specimens submitted to two damp heat cycles in accordance with IEC 68-2-30		N/A

Clause	Requirement – Test	Measuring result – Remark	Verdict
	After the test:		N/A
	Insulation resistance and electric strength test (clause 17)		N/A
	Abrasion test (sub-clause 24.7)		N/A
30.3	Test at low temperature		N/A
	Set of 3 specimens maintained at $-15\text{ °C} \pm 2\text{ °C}$ for 24 h		N/A
	After the test:		N/A
	Insulation resistance and electric strength test (clause 17)		N/A
	Abrasion test (sub-clause 24.7)		N/A
30.4	Impact test at low temperature		N/A
	Specimens maintained at $-15\text{ °C} \pm 2\text{ °C}$ for 24 h subjected to 4 impacts (mass 100 g, height 100 mm) by means of the apparatus shown in figure 30 rotating the specimen through 90° between impacts		N/A
	After the test: no crack of the insulating sleeves		N/A
31	EMC		N/A
	No requirements except when the accessories contain electronic parts Neon lamps are not electronic parts.		N/A
	Accessories with electronic parts must comply with the relevant EMC requirements		N/A



TEST REPORT IEC 61643-11 Low-voltage surge protective devices Part 11: Surge-protective devices connected to low-voltage power systems- Requirements and test methods	
Report Number	70.410.16.104.04-00
Date of issue	2016-05-17
Total number of pages	93
Applicant's name	Ningbo First-Rate Electrical Appliance Co., Ltd.
Address	No. 8-1 Lizhou Street Industry Zone, 315403 Yuyao, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Test specification:	
Standard	IEC 61643-11: 2011 (First Edition)
Test procedure	N/A
Non-standard test method	N/A
Test Report Form No	IEC61643_11B
Test Report Form(s) Originator	OVE
Master TRF	Dated 2012-12
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Test item description	SPD module incorporated in adaptor
Trade Mark	N/A
Manufacturer	Ningbo First-Rate Electrical Appliance Co., Ltd.
Model/Type reference	FR101, FR102, FR103, FR104(the model of adaptors)
Ratings	Uc=250V~, Uoc=6KV (for L-N, L/N-PE) Up=2KV (for L-N, L/N-PE) SPD type 3

Testing procedure and testing location:		
<input checked="" type="checkbox"/>	Testing Laboratory:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Testing location/ address :		No. 1999, Duhui Road, Shanghai, 201108 P. R. China
<input type="checkbox"/>	Associated Laboratory:	
Testing location/ address :		
Tested by (name + signature) :		Ying LIU
Approved by (name + signature)... :		Yi ZHU
		
<input type="checkbox"/>	Testing procedure: TMP	
Testing location/ address :		
Tested by (name + signature) :		
Approved by (name + signature)... :		
<input type="checkbox"/>	Testing procedure: WMT	
Testing location/ address :		
Tested by (name + signature) :		
Witnessed by (name + signature)... :		
Approved by (name + signature)... :		
<input type="checkbox"/>	Testing procedure: SMT	
Testing location/ address :		
Tested by (name + signature) :		
Approved by (name + signature)... :		
Supervised by (name + signature) :		

List of Attachments (including a total number of pages in each attachment):

ATTACHMENT TO TEST REPORT IEC 61643_11B EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES

Summary of testing:**Tests performed (name of test and test clause):**

Complete test.

Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.

Testing location:

TÜV SÜD Certification and Testing (China) Co., Ltd.
Shanghai Branch

No. 1999, Duhui Road, Shanghai, 201108, P. R.
China

Summary of compliance with National Differences

This test report complies with IEC 61643-11: 2011 and EN 61643-11:2012

Copy of marking plate

Uc=250V~

Uoc=6 KV

Up=2 KV

SPD Type3

See marking on label of end product.

Test item particulars	
Number of ports	One port / Two port
SPD design topology	Voltage switching / Voltage limiting / Combination
SPD classified for test class	I/II / III
Location	Indoor / Outdoor
Accessibility	Accessible / Inaccessible
Mounting method	Fixed / Portable
SPD Disconnecter	Internal / External / Both
Protection functions	Thermal / Leakage current / Overcurrent
Overcurrent protection	Specified / Not specified
Degree of protection (IP code)	IP00
Temperature range	Normal / Extended
Required SPD-disconnectors	Internal thermal link
SPD failure behaviour:	open circuit / short circuit
Possible test case verdicts:	
- test case does not apply to the test object.....	: N/A
- test object does meet the requirement	: P (Pass)
- test object does not meet the requirement.....	: F (Fail)
Testing	
Date of receipt of test item	: 2016-04-12
Date (s) of performance of tests	: 2016-04-12 to 2016-05-17
General remarks:	
<p>The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p>	
<p>Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.</p>	

General product information:

SPD module used for incorporated in adaptor.

If not otherwise specified all tests have been carried out on three samples per test sequence. Terminal tests have been carried out on three terminals of each construction used.

Impulse tests have been carried out according to chapters 8.1.1 to 8.1.4.

SPDs according test class I: Calculation of charge Q and specific energy W/R applied during additional duty test acc. to 8.3.4.4

I (kA)	Q (As) within 5 ms	W/R (kJ/Ω)
0,1* I _{imp} = _____	N/A	N/A
0,25* I _{imp} = _____	N/A	N/A
0,5* I _{imp} = _____	N/A	N/A
0,75* I _{imp} = _____	N/A	N/A
1,0* I _{imp} = _____	N/A	N/A

If the SPD is an integral part of a product covered by another standard, the requirements of the other standard were applied to those parts of the product, which do not belong to the SPD section of the product. The SPD section was judged according to the general (7.1), the electrical (7.2), the environmental and material (7.4) requirements. The mechanical requirements of other standards shall also be applied to the SPD.

Unless otherwise specified, a.c. values given in this report are r.m.s. values.

If not otherwise specified the tests have been performed in free air and at an ambient temperature of $(20 \pm 15)^\circ\text{C}$.

If not otherwise specified, for all tests where a power supply at U_{REF} or U_{C} is required, the voltage tolerance for testing was $^{+0}_{-1.5}\%$.

If the SPD is supplied with integral cables, the full length of these cables forms part of the SPD under test, except for the determination of the measured limiting voltage 8.3.3, where a lead length of 150 mm was used.

SPD disconnectors have been selected according to the manufacturer's instructions and connected for testing according to Table 3.

For SPDs having more than one mode of protection, for which the manufacturer declares a voltage protection level, the tests have been performed on each mode, with the values chosen according to the manufacturer's declaration, using new samples each time. For three phase devices in which the protective component circuitry per given mode is identical, the testing may be performed on each of the three phases which fulfils the three sample requirement.

For SPDs with a designated N terminal which may be applied in systems without distributed neutral according to the manufacturer's instructions, separate testing has been performed for the L-PE mode of protection with the neutral being unconnected.

If the manufacturer sets different requirements for the external SPD disconnector(s) depending upon the prospective short-circuit current of the supply system, all relevant test sequences have been performed for every combination of required SPD disconnector(s) and corresponding prospective short-circuit currents.

Throughout the entire type testing procedure, the status shown by the indicator(s) give a clear sign of the status of the part to which it is linked. Where there is more than one method of status indication, for example local and remote indication, each type of indication was checked.

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.1.1/7.1.2	Identification and Marking		P
	<u>Markings on the body or permanently attached to</u>		P
	a1) Manufacturer/Trade mark/Model number	<u>See page 1</u>	P
	a2) Maximum continuous operating voltage U_C (one value for each mode of protection)	<u>250 V</u>	P
	a3) Type of current: a.c. or “~” and/or frequency	<u>~ 50Hz</u>	P
	a4) Test classification and discharge parameters shall be printed next to each other for each mode of protection declared by the manufacturer <u>For test class I:</u> either “test class I” and “ I_{imp} ” and the value in kA, and/or “ T1 ” (T1 in a square) and “ I_{imp} ” and the value in kA <u>For test class II:</u> either “test class II” and “ I_n ” and the value in kA, and/or “ T2 ” (T2 in a square) and “ I_n ” and the value in kA <u>For test class III:</u> either “test class III” and “ U_{OC} ” and the value in kV, and/or “ T3 ” (T3 in a square) and “ U_{OC} ” and the value in kV	____ kA ____ kA $U_{oc}=6kV$ (for L-N, L/N-PE)	N/A N/A P
	a5) Voltage protection level U_p (one value for each mode of protection)	$U_p=2kV$ (for L-N, L/N-PE)	P
	a6) Degree of protection if > IP20	IP ____	N/A
	a7) Identification of terminals or leads	____	N/A
	a8) Rated load current I_L	<u>16A</u>	P
	<u>Information provided with the products</u>		P
	b1) Location	indoor	P
	b2) Number of ports	One	P
	b3) Method of mounting	portable	P
	b4) Short circuit current rating I_{SCCR}	<u>3kA</u>	P
	b5) Ratings and characteristics for external disconnecter	____	N/A
	b6) Indication of disconnecter operation	Indicator Lamp	P
	b7) Orientation for normal installation	In portable socket outlet	P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	b8) Installation instructions - type of LV systems (TN-, TT-, IT-system) - intended connection - nominal a.c. system voltages and maximum allowed voltage regulation for which the SPD is designed, mechanical dimensions, lead lengths, etc.	<u>TN-system</u>	P
	b9) Temperature and humidity range	normal	P
	b10) Follow current interrupting rating I_{fi}	_____	N/A
	b11) Residual current I_{PE}	_____	N/A
	b12) Transition surge current rating for short-circuiting type SPD I_{trans}	_____	N/A
	b13) The minimum distance from any earthed conductive surface at which the SPD can be installed	_____	N/A
	b14) I_{max} (optional)	_____	N/A
	<u>Information which shall be available in a datasheet</u>		N/A
	c1) Temporary overvoltage rating U_T and/or the type(s) of power system(s) the SPD is designed for according to Annex B and corresponding connection details	See table B.1	P
	c2) Total discharge current I_{TOTAL} for multipole SPDs (if declared by the manufacturer) and the corresponding test class	_____	N/A
	c3) Voltage drop for two port SPDs	_____	N/A
	c4) Load-side surge withstand capability for two-port SPDs	_____	N/A
	c5) Information about replaceable parts (indicators, fuses, etc.)	_____	N/A
	c6) Voltage rate of rise du/dt	_____	N/A
	c7) Current factor k , if different from Table 20	_____	N/A
	c8) Modes of protection (for SPDs with more than one mode of protection)	Type3 SPD for L-N, L/N-PE protection mode	P
8.2	Indelibility of markings		P
	This test shall be applied on markings of all types except those made by impressing, molding and engraving.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	The test is made by rubbing the marking by hand for 15s with a piece of cotton soaked with water and again for 15s with a piece of cotton soaked with aliphatic solvent hexane with a content of aromatics of maximum 0,1% volume, a kauributanol value of 29, initial boiling-point approximately 65 °C and a specific gravity of 0,68 g/cm ³ .		P
	After this test, the marking shall be easily legible.		P
7.3.1	Mounting		P
	SPDs shall be provided with appropriate means for mounting that will ensure mechanical stability. Mechanical coding/interlock shall be provided to prevent incorrect combinations of plug-in SPD modules and sockets. Compliance is checked by visual inspection.		P
	Terminals and connections		N/A
7.3.2	Screws, current carrying parts and connections	Soldered on PCB	N/A
8.4.1	Reliability of screws, current-carrying parts and connections		N/A
	Screws operated when connecting the SPD:		N/A
	The screws are tightened and loosened: - ten times for screws in engagement with a thread of insulating material - five times in all other cases		N/A
	Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time unless the construction of the screw prevents this.		N/A
	The test is made by means of a suitable test screwdriver or spanner applying a torque as shown in Table 10 or according to the manufacturer's specification, whichever is greater.		N/A
	The screws shall not be tightened in jerks.		N/A
	The conductor is moved each time the screw is loosened.		N/A
	During the test, the screwed connections shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the SPD.		N/A
	Enclosures and covers shall not be damaged. This shall be verified by visual inspection.		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3	External connections		N/A
8.4.2	Terminals for external conductors		N/A
	<p>The SPD is mounted according to the manufacturer's recommendation on a dull, black-painted board of about 20mm thickness, and protected against undue external heating or cooling.</p> <p>SPD terminals wired with conductors according to:</p> <ul style="list-style-type: none"> - table 11, for two-port devices and one port devices with separate input/output terminals or, - the manufacturer's instruction, for other one-port devices 	<p>_____ A</p> <p>_____ to _____ mm²</p> <p>_____ to _____ mm²</p>	N/A
	SPDs tested according to class I and one-port SPDs with a nominal discharge current ≥ 5 kA tested according to class II shall be capable of clamping conductors up to a cross-section of at least 4 mm ²		N/A
	Terminals shall be fastened to the SPD in such a way that they will not work loose if the clamping screws or the lock nuts are tightened or loosened. A tool shall be required to loosen the clamping screws or the lock nuts.		N/A
	Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently. The terminals shall be readily accessible under the intended conditions of use.		N/A
	The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.		N/A
	Terminals shall have adequate mechanical strength.		N/A
	Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.		N/A
	Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.		N/A
	Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.		N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.3.3.1	Terminals with screws		
	Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.		N/A
	Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to the SPDs.		N/A
	These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, but any movement shall be sufficiently limited so as to prevent non-compliance with the requirements of this standard.		N/A
	The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that: <ul style="list-style-type: none"> • The sealing compound or resin is not subject to stress during normal use, and • The effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the least favourable conditions specified in this standard. 		N/A
	Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.		N/A
	Screws shall not be made of metal that is soft or liable to creep, such as zinc or aluminium.		N/A
8.4.2.1.1	General		
	These tests are made by means of a suitable screwdriver or spanner applying a torque as shown in table 10.	_____ mmØ _____ Nm	N/A
	The terminals are fitted with copper conductors of the smallest or largest cross-sectional areas specified in 8.4.2, solid or stranded, whichever is least favourable	_____ to _____ mm ²	N/A
	The conductor is inserted into the terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side, and in the position most likely to assist the wire to escape		N/A
	The clamping screws are then tightened with a torque to two-thirds of that shown in the appropriate column of table 10.	_____ Nm	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	Each conductor is then subjected to a pull of the value, in newtons, shown in table 12. The pull is applied without jerks, for 1 min, in the direction of the axes of the conductor space.	_____ N	N/A
	During this test, the conductor shall not move noticeably in the terminal		N/A
8.4.2.1.2 a)	The terminals are fitted with cooper conductors (solid or stranded), of the smallest or largest-sectional areas as specified in 8.4.2, (whichever is the least favourable) and the terminal screws are tightened with a torque equal to two-thirds of the values shown in the appropriate column of table 10. The terminal screws are then loosened and the part of the conductor which may have been affected by the terminal is inspected.	min. _____ mm ² max. _____ mm ²	N/A
	The conductors shall show neither undue damage nor severed wires		N/A
	Conductors are considered to be unduly damaged if they show deep or sharp indentations.		N/A
	During the test, terminals shall not work loose and there shall be no damage such as breakage of screws or damage to the head slots, threads, washers or stirrups, that will impair the further use of the terminal.		N/A
8.4.2.1.2 b)	The terminals are fitted with a rigid stranded cooper conductor according to table 13.	_____ to _____ mm ²	N/A
	Before insertion in the terminal, the wires of the conductors are suitably reshaped		N/A
	The conductor is inserted into the terminal until the conductor reaches the bottom of the terminal or just projects from the far side of the terminal and in the position most likely to assist a wire to escape. The clamping screw or nut is then tightened with a torque equal to two-thirds of that shown in the appropriate column of table 10	_____ mmØ _____ Nm	N/A
	After the test, no wire of the conductor shall have slipped out of the SPD terminal.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
7.3.3.2	Screwless terminals		
	Terminals shall be so designed and constructed that: <ul style="list-style-type: none"> each conductor is clamped individually. During the connection or disconnection the conductors can be connected or disconnected either at the same time or separately, it is possible to clamp securely any number of conductors up to the maximum provided 		N/A
8.4.2.2	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2		N/A
	Each conductor is then subjected to a pull of the value shown in table 14. The pull is applied without jerks for 1 min in the direction of the axis of the conductor.	_____ to _____ mm ² _____ N	N/A
8.4.2.3	Insulation piercing connections		
8.4.2.3.1	Pull test on terminals designed for single core conductors		
	The terminals are fitted with new cooper conductors (solid or stranded), of the smallest or largest cross-sectional areas as specified in 8.4.2, (whichever is the least favourable). Screws, if any, are tightened according to Table 10.	_____ mmØ _____ Nm	N/A
	The conductors are connected and disconnected five times, new conductors being used each time. After each connection the conductors are subjected to a pull, without jerks, for 1 min in the axis of the tapping conductor according to the value given in Table 14.	_____ to _____ mm ² _____ N	N/A
	During the test, there shall be no movement of the conductor in the terminal or any sign of damage.		N/A
8.4.2.3.2	Pull test on terminals designed for multi-core cables or cords		
	The pull-out test on the SPD terminals designed for multi-core cables or cords is carried out as for single core conductors, except that the pull force is applied to the entire multi-core cable or cord instead of to the individual core.	min. _____ mm ² max. _____ mm	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	<p>The pull force is calculated according to the following formula:</p> $F = F(x) \sqrt{n}$ <p>F is the total force to apply n is the number of cores $F(x)$ is the force for one core according to the cross-section of one conductor (see table 9)</p>	<p>$F(x) = \underline{\hspace{2cm}}$ N $n = \underline{\hspace{2cm}}$ $F = \underline{\hspace{2cm}}$ N</p>	N/A
	During the test, the cable or cord shall not slip out of the terminals.		N/A
8.4.2.4	Flat quick connect terminations		
	Under consideration		
8.4.2.5	Pigtail connections (flying leads)		
8.4.2.5.1	Pull test on flying lead conductors		N/A
	A flying lead and anchorage shall withstand without damage or detachment a direct pull of 89N for one minute, applied to the lead from any angle which the construction or the device will allow.		N/A
	During the test, there shall be no movement of the conductor or any sign of damage.		N/A
7.2.1	Protection against direct contact		
	Test applied to SPDs with $U_C > 50V$ r.m.s.	$U_C=250V\sim$	P
	For protection against direct contact (inaccessibility of live parts), SPDs shall be so designed that, when they are wired and mounted as for normal use, live parts are not accessible, even after removal of parts which can be removed without the use of a tool.	Incorporated in adaptor	P
8.3.1.1	Insulated parts		
	The sample is mounted as for normal use and the test is conducted using conductors of the smallest cross-sectional area and then again using conductors of the largest cross-sectional area specified in 8.4.2.		P
	The standard test finger (in accordance with IEC 60529) is applied in every possible position.	Evaluated in the end products	P
	For plug-in SPDs (which can be changed without a tool), the test finger is applied in every possible position, when the plug is partially inserted or completely inserted in a socket outlet.		N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	An electrical continuity indicator operating from a voltage of not less than 40V and not more than 50V, one side of which is connected to the test finger to check for the possibility of contact with any live part or the sample.		P
8.3.1.2	Metal parts		
	Metal parts which are accessible when the SPD is wired and mounted as for normal use are connected to earth through a low resistance connection, except of small screws and the like, isolated from live parts, for fixing bases and covers or cover plates of socket-outlets.	No accessible metal parts	N/A
	A current (derived from an a.c. source having a no-load voltage not exceeding 12 V) equal to 1,5 times the rated load current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.	_____ A	N/A
	The voltage drop between the earthing terminal and the accessible metal part is measured and the resistance is calculated from the current and this voltage drop. The resistance shall not exceed 0,05 Ω .	_____ mV _____ Ω	N/A
7.4.1	Environment, IP code		
	SPDs shall be provided with an enclosure for protection against ingress of solid objects and water in accordance with the IP code declared by the manufacturer.		P
8.5.1	Test carried out acc. to IEC 60529 to check IP code	IP <u>20</u>	P
7.2.2	Residual current I_{PE}		
	For all SPDs with a terminal for the protective conductor, the residual current I _{PE} shall be measured when all SPD terminals are connected to a power supply at the reference test voltage (U _{REF}) according to the manufacturer's instructions.		P
8.3.2	The SPD shall be connected as for normal use according to the manufacturer's instructions. The voltage shall be adjusted to the reference test voltage of U _{REF} . The residual current flowing through the PE terminal is measured.	U _{REF} <u>255V</u> I _{PE} <u>0,05mA(Max.)</u>	P
7.2.4/8.3.4	Operating duty		
	The SPD shall be capable of withstanding specified discharge currents during application of the maximum continuous operating voltage U _C without unacceptable changes in its characteristics. The test setup shall comply with the circuit diagram given in Figure 7.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Determination of the measured limiting voltage:		
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	U_{oc} : 6.0kV	P
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P	_____ kV	N/A
	Sample connected to power frequency source at U_C	<u>250</u> V	P
8.3.4.2.1	SPDs with follow current < 500A: Voltage at SPD terminals does not fall below the peak value of U_C by more than 10% during flow of follow current	No follow current	N/A
8.3.4.2.2	SPDs with follow current > 500A: Power frequency voltage U_C with a prospective short circuit current equal to the follow current interrupt rating I_{fi} declared by the manufacturer in accordance with Table 8, or 500A, whichever is greater. For SPDs connected between neutral and protective earth only, the prospective short-circuit current shall be at least 100A.	_____ kA $\cos \varphi =$ _____	N/A
8.3.4.3	Class I and II operating duty tests		
	Three groups of five impulses of 8/20 current impulses with positive polarity shall be applied. The test samples are connected to a power source according to 8.3.4.2. Each impulse shall be increased in steps of 30° with a tolerance of $\pm 5^\circ$ for each synchronisation angle. time interval between the impulses 50s – 60s time interval between the groups 30 min – 35 min	_____ kA sync. 0°, 30°, 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, 300°, 330°, 0°, 30°, 60° el.	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be energized at U_C. The prospective short-circuit current of the power source shall comply with 8.3.4.2 during the application of groups of impulses.</p> <p>After the application of each group of impulses and after the interruption of the last follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for reignition.</p> <p>After the last group of impulses and the 1 min period the SPD either remains applied or is reapplied within less than 30s to U_C for another 15 min to check for stability. For that purpose, the short-circuit capability of the power source (at U_C) may be reduced to 5A.</p>	$U_C = \text{_____ V}$	N/A
	When testing SPDs to class I, 8/20 current impulses with a crest corresponding to I_{imp} shall be applied.	see Annex 1	N/A
	When testing SPDs to class II, 8/20 current impulses with I_n shall be applied.	see Annex 1	N/A
	Current records show no sign of puncture or flashover of the sample		N/A
8.3.4.5	Class III operating duty tests		
	<p>The SPD is tested with three groups of impulses corresponding to U_{OC} with:</p> <ul style="list-style-type: none"> - five positive impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) - five negative impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) - five positive impulses initiated at crest value of positive half cycle ($\pm 5^\circ$) 	L-N: 6,0 kV L/N-PE: 6,0 kV	P
8.3.4.4	Additional duty test for test class I		N/A
	<p>This test is carried out with current impulses in steps up to I_{imp} passing through the SPD.</p> <p>SPD energized at U_C by a voltage source having a nominal current capability of 5A during the application of impulses.</p>	$U_C = \text{_____ V}$	N/A

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Clause	Requirement - Test	Result - Remark	Verdict
	Current impulses of positive polarity shall be initiated in the corresponding positive crest value of the power frequency voltage source to the energized test sample as follows: a) One current impulse at 0,1 I _{imp} b) One current impulse at 0,25 I _{imp} c) One current impulse at 0,5 I _{imp} d) One current impulse at 0,75 I _{imp} e) One current impulse at 1,0 I _{imp}	____ kA ____ kA ____ kA ____ kA ____ kA	N/A
	After each impulse cool down to ambient temperature		P
8.3.4.6	Pass criteria		
A	After the application of each impulse and after interruption of each follow current (if any) the SPD shall remain energized without interruption for at least 1 min to check for re-ignition. After that period the SPD either remains applied or is reapplied within less than 30s to U _C for another 15 min to check for stability. For that purpose the short-circuit capability of the power source shall also be 5A.		P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
D	Determination of the measured limiting voltage:	U _P ≤ <u>2,0</u> kV	
	according to 8.3.3.1, but only at a crest value corresponding to I _{imp} for test class I	____ kA / ____ V	N/A
	according to 8.3.3.1, but only at I _n for test class II	____ kA / ____ V	N/A
	according to 8.3.3.3, but only at U _{OC} for test class III	L-N: <u>1,9</u> kA / <u>1,7</u> kV L/N-PE: <u>2,2</u> kA/ <u>1,8</u> kV	P
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U _P	____ kV	N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		P

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Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_{REF} = 255 \text{ V}$</p> <p><1 mA</p>	P
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	<p>$U_C = \text{___} \text{ V}$</p> <p>test voltage</p> <p>$\text{___} \text{ V}$</p>	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_C = 250 \text{ V}$</p> <p><1 mA</p>	P
F	External disconnectors shall not operate during the test and shall be in working order after the test.		P
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
7.2.5.2	Thermal protection		
	SPDs shall be protected against overheating due to degradation or overstress		P
	This test is not performed on SPDs containing only switching components and/or ABD devices.		P
7.2.5.4	Status indicator		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.		P
	A status indicator may be composed of two parts (one of which is not replaced on replacement of the SPD), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced shall be capable of operating at least 50 times.		P
	Where there is an appropriate standard for the type of indication used, this shall be met by the non-replaced part of the status indicator, with the exception that the indicator need only be tested for 50 operations.		N/A
8.3.5.2	Thermal stability		
	If different non-linear components connected in parallel, this test has to be performed for every current path of the SPD by disconnecting/interrupting all the remaining current path. If components of the same type and parameters are connected in parallel, they shall be tested as one current path.		P
	Any voltage switching component within the current path under test, which is connected in series with a voltage limiting component shall be short-circuited by a cooper dummy with a diameter such that it does not melt during the test.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Test for SPDs containing only voltage limiting components - procedure a)		
	<p>Sample connected to power frequency source with a voltage high enough to drive a constant current, which is increased by the following steps – 2mA or 5% of the previously adjusted test current, whichever is greater – with a tolerance of $\pm 10\%$:</p> <p><u>2</u> mA r.m.s. or corresponding crest value <u>5</u> mA r.m.s. or corresponding crest value <u>10</u> mA r.m.s. or corresponding crest value <u>20</u> mA r.m.s. or corresponding crest value <u>30</u> mA r.m.s. or corresponding crest value <u>40</u> mA r.m.s. or corresponding crest value _____ mA r.m.s. or corresponding crest value _____ mA r.m.s. or corresponding crest value _____ mA r.m.s. or corresponding crest value _____ mA r.m.s. or corresponding crest value _____ mA r.m.s. or corresponding crest value</p>	<p>duration</p> <p><u>0,2h</u> <u>0,2h</u> <u>0,2h</u> <u>0,2h</u> <u>0,2h</u></p> <p>after 6 min, thermal-link operated</p>	P
	Each step is maintained until thermal equilibrium is reached – temperature variation $< 2K$ within 10 min		P
	Surface temperature of the hottest spot and current through the SPD are monitored continuously		P
	Test interrupted if all non-linear components under test are disconnected. The voltage is not increased further in order to avoid any malfunction of the disconnectors.		P
	For the other two samples the starting point shall be changed from 2 mA to a current corresponding to 5 steps below the current value at which the first sample disconnected		P
	<p>If the voltage across the SPD falls below U_{REF} during the test, the current regulation is discontinued and the voltage is adjusted back to U_{REF} and maintained for a duration of 15 min. Continuous current monitoring is no longer required.</p> <p>Source short-circuit current capability does not limit the current before any disconnector operates. The maximum available current value does not exceed the short circuit withstand capability declared by the manufacturer.</p>	<p>$U_{REF} = \underline{\hspace{1cm}} V$</p> <p><u> </u> V <u> </u> kA cos phi = <u> </u></p>	N/A

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	Test for SPDs having a voltage switching component in series with other components – procedure b)		
	SPD energized with a power frequency source at U_{REF} having a short-circuit current capability which will not limit the current before any disconnecter operates. The maximum available current value does not exceed the short-circuit withstand capability declared by the manufacturer.	_____ V _____ kA cos phi = _____	N/A
	If no significant current flows – test procedure a) shall be followed		N/A
	Pass criteria		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	<u>250</u> V <1 mA	P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	<u>≤1</u> mA	P
M	There shall be no explosion or other hazard to either personnel or the facility		P
O	After completion of this test the samples shall be allowed to return to room temperature and be connected to a power source at U_C for 2 hours. The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10%.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	In addition for indoor SPDs the surface temperature rise shall not exceed 120K during and after the test. 5 min. after disconnection of all non-linear components under test the surface temperature rise shall not exceed 80K.	<55 K <43 K	P
7.3.4/8.4.3	Verification of air clearances and creepage distances		
	SPDs for domestic and similar applications shall be designed for pollution degree 2.		P
	SPDs for more stringent environmental applications may require special precautions, e.g. an appropriate SPD housing or an additional enclosure, which will ensure pollution degree 2 for the SPD		P
	For SPDs for outdoor and out of reach applications pollution degree 4 applies. This may be reduced to pollution degree 3 for internal distances, if they are covered by an adequate housing ensuring pollution degree 3 conditions.		N/A
	The electrode spacing of spark gaps shall not be considered for the determination of air clearances and creepage distances.		P
	The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16.		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>Air clearances in millimetres</p> <p>U_{\max} <u>250</u> V</p> <p>required / measured</p> <p>1) Between live parts of different polarity 3mm / >3mm (by gauge)</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD 3mm / >3mm (by gauge) – fastening surfaces (note 2) 6mm / >6mm (by gauge) – screws or other means for fastening the SPD (note 2) 3mm / >3mm (by gauge) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) _____ / _____ – screws or other means for fastening the SPD _____ / _____ <p>NOTE 1 – Definition see 8.3.6 a)</p> <p>NOTE 2 – If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of lines 1 are sufficient.</p> <p>Creepage distances in millimetres</p> <ul style="list-style-type: none"> – r.m.s. voltage <u>250V</u> – Material group <u>IIIa</u> – Pollution <u>2</u> – distances required 3mm / 3mm <p>Printed wiring material</p> <ul style="list-style-type: none"> – r.m.s. voltage <u>250V</u> – Material group <u>IIIa</u> – Pollution <u>2</u> – distances required 3mm / 3mm 		P

IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.4.2/8.5.3	Ball pressure test		
	Outer parts of SPDs, consist of insulating material, are submitted to a ball pressure test by means of a tester as shown on Figure 20 and 21.		P
	Parts of insulating material necessary to retain current carrying parts and parts of the earthing circuit in position are tested in a heating cabinet at $125^{\circ}\text{C} \pm 2 \text{ K}$.	PCB	P
	Parts of insulating material not necessary to retain current carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are tested at $70^{\circ}\text{C} \pm 2 \text{ K}$.		N/A
	The sample to be tested is fastened accordingly, its surface being positioned horizontally; a steel ball having a diameter of 5 mm is pressed against the surface with a force of 20 N.		P
	After 1 h, the steel ball is taken away from the sample; by dipping it into cold water, the temperature of the sample is reduced to ambient temperature within 10 s.		P
	Pass criteria		
	The diameter of the ball indentation is measured and shall not exceed 2 mm.	<u>0,6</u> mm	P
7.4.3/8.5.4	Resistance to abnormal heat and fire		
	Insulating parts of the housing shall be either non-flammable or self-extinguishing. The glow wire test is performed in accordance with Clauses 4 to 10 of IEC 60695-2-11 under the following conditions: <ul style="list-style-type: none"> • for external parts of SPDs made of insulating material necessary to retain in position current-carrying parts and parts of the protective circuit, by the test made at a temperature of $850^{\circ}\text{C} \pm 15 \text{ K}$. • for all other external parts made of insulating material, by the test made at a temperature of $650^{\circ}\text{C} \pm 10 \text{ K}$. 	850 °C(for PCB)	P
	The test is not made on parts of ceramic material and parts with lower size than defined in 3.1 of IEC 60695-2-11.		N/A
	If the insulating parts are made of the same material, the test is carried out only on one of these parts, according to the appropriate glow-wire test temperature.		N/A
	The test is made on one sample		P

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Clause	Requirement - Test	Result - Remark	Verdict
	In case of doubt, the test is repeated on two additional samples.		N/A
	The test is made by applying the glow-wire once.		P
	The sample shall be positioned during the test in the least favourable position of its intended use (with the surface tested in a vertical position).		P
	The tip of the glow-wire shall be applied to the specified surface of the test sample taking into account the conditions of intended use under which a heated or glowing element may come into contact with the sample.		P
	Pass criteria		
	<p>The sample is regarded as having passed the glow-wire test if</p> <ul style="list-style-type: none"> • there is no visible flame and no sustained glowing or if, • flames and glowing parts on the sample extinguish themselves within 30 s after the removal of the glow-wire. 	no visible flame	P
	There shall be no ignition of the tissue paper or scorching of the pinewood board.		P
7.4.4/8.5.5	Tracking resistance		
	The test is performed according to IEC 60112, solution A with a test voltage depending on the measured creepage distances and the required material group according to 8.3.4.	175V	P

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Clause	Requirement - Test	Result - Remark	Verdict
7.2.3/8.3.3	Voltage protection level		
	The measured limiting voltage of the SPDs shall not exceed the voltage protection level that is specified by the manufacturer.		P
	All one-port SPDs shall be tested unenergized.		P
	All two-port SPDs shall be tested energized for the tests according 8.3.3.1 and 8.3.3.3 by means of a voltage source having a nominal current of at least 5 A at U_C . Positive impulses are applied at the $(90 \pm 5)^\circ$ point and negative impulses at $(270 \pm 5)^\circ$ point on the sinusoidal voltage waveform.		N/A
	For a one-port SPD having terminals, the test is performed without external disconnectors and the voltage is measured at the terminals. For a one-port SPD having connecting leads the voltage is measured with external lead lengths of 150mm. For a two-port SPD, and a one-port SPD having separate load terminals, the voltage for determining the measured limiting voltage is measured at the output/load port or load terminals of the SPD and the voltage for determining U_{max} is measured at the input/line port or terminals of the SPD.		P
8.3.3.1	Residual voltage with 8/20 current impulses		
	Class I, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times the crest value of I_{imp} shall be applied. 0,1 times I_{imp} 0,2 times I_{imp} 0,5 times I_{imp} 1,0 times I_{imp} Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied. 0,1 times I_n 0,2 times I_n 0,5 times I_n 1,0 times I_n If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.	____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V ____ kA / ____ V	N/A
	When I_{max} is declared by the manufacturer an additional 8/20 current impulse with a crest value of I_{max} shall be applied and the residual voltage shall be measured and recorded.	____ kA / ____ V	N/A

IEC 61643-11 - TEST SEQUENCE 2			
Clause	Requirement - Test	Result - Remark	Verdict
	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD		N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	Current and voltage oscillogram	see Annex 2	N/A
	Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}	see Annex 3	N/A
	The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for: <ul style="list-style-type: none"> • class I: up to I_{imp} • class II: up to I_n 	<p>_____ V</p> <p>_____ V</p>	N/A
	The value for determining U_{max} is the highest residual voltage measured at I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.	_____ V	N/A
8.3.3.2	Front-of-wave sparkover voltage		
	The 1,2/50 voltage impulse is used. The generator is set to an open circuit output voltage of 6 kV.		N/A
	10 impulses are applied to the SPD, five of positive and five of negative polarity.		N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	If sparkover is not observed during each of the 10 impulses on the front of wave, then the above procedure are repeated with the generator output voltage increased up to a maximum 10 kV.		N/A
	Voltage oscillograms	see Annex 4	N/A
	The value for determining the measured limiting voltage and U_{max} is the maximum sparkover voltage recorded during this test.	_____ V	N/A
8.3.3.3	Limiting voltage with the combination wave		
	To perform this test a combination wave generator is used.		P
	The interval between the individual impulses shall be long enough for the sample to cool down to ambient temperature.		

IEC 61643-11 - TEST SEQUENCE 2																							
Clause	Requirement - Test	Result - Remark	Verdict																				
	<p>The voltage of the combination wave generator is set to provide an open-circuit voltage of 0,1; 0,2; 0,5; 1,0 times the U_{OC}.</p> <p>If the SPD only contains voltage-limiting components this test needs to be carried out at U_{OC} only.</p> <table border="0" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">L-N</td> <td style="text-align: center;">L/N-PE</td> <td></td> </tr> <tr> <td>0,1 times U_{OC}</td> <td style="text-align: center;"><u>0,6</u> kV</td> <td style="text-align: center;"><u>0,6</u> kV</td> <td></td> </tr> <tr> <td>0,2 times U_{OC}</td> <td style="text-align: center;"><u>1,2</u> kV</td> <td style="text-align: center;"><u>1,2</u> kV</td> <td></td> </tr> <tr> <td>0,5 times U_{OC}</td> <td style="text-align: center;"><u>3,0</u> kV</td> <td style="text-align: center;"><u>3,0</u> kV</td> <td></td> </tr> <tr> <td>1,0 times U_{OC}</td> <td style="text-align: center;"><u>6,0</u> kV</td> <td style="text-align: center;"><u>6,0</u> kV</td> <td></td> </tr> </table>		L-N	L/N-PE		0,1 times U_{OC}	<u>0,6</u> kV	<u>0,6</u> kV		0,2 times U_{OC}	<u>1,2</u> kV	<u>1,2</u> kV		0,5 times U_{OC}	<u>3,0</u> kV	<u>3,0</u> kV		1,0 times U_{OC}	<u>6,0</u> kV	<u>6,0</u> kV		<p style="text-align: center;">L-N</p> <p><u>0,01</u> kA / <u>0,62</u> kV</p> <p><u>0,09</u> kA / <u>1,22</u> kV</p> <p><u>0,73</u> kA / <u>1,32</u> kV</p> <p><u>1,86</u> kA / <u>1,7</u> kV</p> <p style="text-align: center;">L/N-PE</p> <p><u>0,01</u> kA / <u>0,73</u> kV</p> <p><u>0,03</u> kA / <u>1,27</u> kV</p> <p><u>1,0</u> kA / <u>1,8</u> kV</p> <p><u>2,2</u> kA / <u>1,7</u> kV</p>	P
	L-N	L/N-PE																					
0,1 times U_{OC}	<u>0,6</u> kV	<u>0,6</u> kV																					
0,2 times U_{OC}	<u>1,2</u> kV	<u>1,2</u> kV																					
0,5 times U_{OC}	<u>3,0</u> kV	<u>3,0</u> kV																					
1,0 times U_{OC}	<u>6,0</u> kV	<u>6,0</u> kV																					
	With these generator settings four surges will be applied to the SPD at each amplitude: two with positive and two with negative polarity.		P																				
	Current-voltage oscillograms; voltage at the output port of the SPD	see Annex 2	P																				
	The value for determining the measured limiting voltage and U_{max} is the maximum voltage recorded during the test.	<p>L-N: 1,7 kV</p> <p>L/N-PE: 1,8 kV</p>	P																				
8.3.3.4	Pass criteria for all measured limiting voltage tests																						
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P																				
C	No mechanical damage		P																				
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A																				
M	There shall be no explosion or other hazard to either personnel or the facility		P																				

IEC 61643-11 - TEST SEQUENCE 2a Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.2/8.7.3	Load-side surge withstand capability		
	<p>For this test:</p> <ul style="list-style-type: none"> • 15 current impulses 8/20 or, • 15 combination wave impulses with an open-circuit voltage U_{OC} <p>with a value equal to the load-side surge withstand capability declared by the manufacturer are applied in three groups of five impulses to the output port of the test sample. The SPD is energized at U_C by means of a voltage source having a nominal current of at least 5 A. Each impulse shall be synchronized to the power frequency. Starting from 0° the synchronization angle shall be increased in steps of $(30 \pm 5)^\circ$.</p>	<p>_____ kA</p> <p>_____ kV</p>	N/A
	The interval between the impulses is 50 s to 60 s and the interval between the groups is 30 min to 35 min.		N/A
	The test sample shall be energized during the whole test sequence. The voltage on the output terminals shall be recorded.		N/A
	Pass criteria		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq$ _____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	<p>SPDs tested acc. to class I and II containing switching components:</p> <p>Front-of-wave sparkover voltage acc. to 8.3.3.2</p> <p>All measured peak values (5 pos./5 neg.) below U_P</p>	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A

IEC 61643-11 - TEST SEQUENCE 2a Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_C = \text{_____ V}$ test voltage _____ V	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
F	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.3	Load-side short-circuit current behaviour		
	The SPD shall be able to carry the currents caused by a power short-circuit on the load side until it is interrupted either by the SPD itself or by an internal or external disconnecter.		
8.6.1.3	This test applies to all SPDs, except those classified for outdoor use and mounted out of reach and those connected N-PE for use in TN and/or TT systems only.		N/A
	The test settings and the test procedure according to 8.3.5.3 (excluding 8.3.5.3.1) are repeated without short-circuiting any components, but with a short-circuit link connected to the following output terminals of the SPD as applicable: <ul style="list-style-type: none"> • short-circuit link across all phase terminals and the neutral terminal (if applicable) on the load side • short-circuit link across all terminals on the load side, with a conductors of the largest cross-section specified under 8.4.2 and with a length of 500 mm each.		N/A
	Pass criteria		
C	No mechanical damage		N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	$U_C = \underline{\hspace{2cm}} \text{ V}$ test voltage $\underline{\hspace{2cm}} \text{ V}$	N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none">• shall not exceed a value of 1 mA or <ul style="list-style-type: none">• the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence	$U_C = \underline{\hspace{2cm}} \text{ V}$ $I_{PE} = \underline{\hspace{2cm}} \text{ mA}$	N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	$\underline{\hspace{2cm}} \text{ V}$ $\underline{\hspace{2cm}} \text{ mA}$	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	$\underline{\hspace{2cm}} \text{ mA}$	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A

IEC 61643-11 - TEST SEQUENCE 2b Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
M	There shall be no explosion or other hazard to either personnel or the facility.		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
	a) Internal disconnecter(s) have operated:		
	After removing the short-circuit links from output terminals and with U_{REF} applied according to the circuit shown in Figure 22, there shall be no voltage on the output terminals.		N/A
	With a power frequency voltage equal to two times U_C applied between all corresponding input and output phase terminals for 1 min there shall be no current flow in excess of 0,5 mA.		N/A
	a) No internal disconnecter has operated:		
D	Determination of the measured limiting voltage:	$U_P \leq \underline{\hspace{2cm}} \text{ V}$	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	$\underline{\hspace{2cm}} \text{ kA} / \underline{\hspace{2cm}} \text{ V}$	N/A
	according to 8.3.3.1, but only at I_n for test class II	$\underline{\hspace{2cm}} \text{ kA} / \underline{\hspace{2cm}} \text{ V}$	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	$\underline{\hspace{2cm}} \text{ kA} / \underline{\hspace{2cm}} \text{ V}$	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P	$\underline{\hspace{2cm}} \text{ kV}$	N/A

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.6/8.3.6	Insulation resistance		
	<p>The insulation resistance of the SPD shall be sufficient with respect to leakage currents and protection against direct contact.</p> <p>This test is not applicable to SPDs having a metallic enclosure connected to protective earth.</p>		P
	Additional entry holes for cables, if there are any, are left open. If there are any knockouts, one of them is opened. Coverings and other parts which are detachable without tools, are removed and undergo the same moisture treatment.		N/A
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of $93\% \pm 3\%$ RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature T between 20°C and 30°C . Before putting the test samples into the humidity cabinet, they shall have a temperature between T and (T+4) in $^{\circ}\text{C}$.		P
	The samples shall be kept in the humidity cabinet for 2 days (48 h).		P
	After a delay of between 30 min and 60 min following the humidity treatment, the insulation resistance is measured 60 s after having applied a d.c. voltage of 500 V.		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>This measurement is carried out in the humidity cabinet or in the room into which the specimens were brought to reach the determined temperature, after having refitted the parts which might have been detached.</p> <p>a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test</p> <p>b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.</p>		P
	Pass criteria		
	<p>The insulation resistance shall not be lower than</p> <ul style="list-style-type: none"> • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b). 	<p><u>>6,5</u> MΩ</p> <p>_____ MΩ</p>	P
7.2.7/8.3.7	Dielectric withstand		
	The dielectric withstand of the SPD shall be sufficient with respect to insulation breakdown and protection against direct contact.		
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed. During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1.		N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		P

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between the live parts of the SPD main circuit and live parts of separate isolated circuits, if there are any.</p>	<p>test voltage</p> <p>2200 V</p>	P
	Pass criteria		
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change the discharge is less than 5%.		P
	The power transformer used for testing shall be designed in such a way that after having been adjusted to the test voltage at its open terminals it will generate a short-circuit current of at least 200 mA after short-circuiting the terminals. An overcurrent relay, if any, shall only react if the test circuit current exceeds 100 mA. The device for measuring the test voltage shall have a precision of $\pm 3\%$.		P
7.3.5/8.4.4	Mechanical strength		
	All parts of the SPD relating to the protection against direct contact shall have sufficient mechanical strength.		
	The samples are subjected to strikes by means of an impact-test apparatus as shown in Figure 18 and Figure 19.		N/A
	Samples are mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edges to a ridged bracket.		N/A

IEC 61643-11 - TEST SEQUENCE 3												
Clause	Requirement - Test	Result - Remark	Verdict									
	Portable SPDs are tested as fixed SPDs, but they are fixed to the plywood sheet by auxiliary means.		N/A									
	Flush-type SPDs are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood. (They are not tested in their relevant mounting boxes.)		N/A									
	If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.		N/A									
	Flush-type screw fixing SPDs shall be fixed by means of screws to lugs recessed in the block.		N/A									
	Flush-type claw fixing SPDs shall be fixed to the block by means of the claws.		N/A									
	Before applying the strikes, fixing screw of bases and covers are tightened with a torque equal to two-thirds of that specified in Table 10.	_____ Nm	N/A									
	<p>The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot. The striking element is allowed to fall from a height which is specified in the following Table 18:</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">parts A and B</td> <td style="width: 30%;">h = 100 mm</td> <td style="width: 30%; text-align: center;">_____</td> </tr> <tr> <td>parts C</td> <td>h = 150 mm</td> <td style="text-align: center;">_____</td> </tr> <tr> <td>parts D</td> <td>h = 200 mm</td> <td style="text-align: center;">_____</td> </tr> </table> <p>A: parts on the front surface, including parts which are recessed.</p> <p>B: Parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p> <p>C: Parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p> <p>D: Parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.</p>	parts A and B	h = 100 mm	_____	parts C	h = 150 mm	_____	parts D	h = 200 mm	_____		N/A
parts A and B	h = 100 mm	_____										
parts C	h = 150 mm	_____										
parts D	h = 200 mm	_____										
	The heights of the fall determined by the part of the sample which projects most from the mounting surface is applied on all parts of the sample, with the exception of parts A		N/A									

IEC 61643-11 - TEST SEQUENCE 3			
Clause	Requirement - Test	Result - Remark	Verdict
	The samples are subjected to strikes which are evenly distributed over the samples. The strikes are not applied to "knock-out" areas.		N/A
	<p>The following blows are applied:</p> <ul style="list-style-type: none"> • for parts A, five strikes: one in the centre. After the sample has been moved horizontally: one each on the unfavourable points between the centre and the edges; and then, after the sample has been turned 90° about its axis perpendicular to the plywood, one each on similar points; • for parts B (as far as applicable), C and D, four blows: <ul style="list-style-type: none"> – one on one side of the sample of the sample after the plywood sheet has been turned 60° and one blow on another side of the sample after it has been turned 90° about its axis perpendicular to the plywood sheet, keeping the position of the plywood sheet unchanged; – one blow on each of the other two sides of the sample, with the plywood sheet turned 60° in the opposite direction. 		N/A
	Pass criteria		
	After the test, the sample shows no damage within the meaning of the standard. In particular, live parts have not become accessible with the standard test finger.		N/A
	Damage to the finish small dents which do not reduce creepage distances or clearances and small chips which do not adversely affect the protection against electric shock or harmful ingress of water are neglected		N/A
	Cracks not visible with the normal or corrected vision, without additional magnification, and surface cracks in fibre reinforced mouldings and the like are ignored.		N/A
7.2.5/8.3.5.1	Temperature withstand		
	The SPD is kept in a heated cabinet at an ambient temperature of 80 °C ± 5 K for 24 h.		P
	Pass criteria		
C	No mechanical damage		P
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
Remarks:			

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.3	Where a SPD includes a circuit that is electrically isolated from the main circuit, the manufacturer shall provide information about the isolation and dielectric withstand voltages between the circuits as well as the relevant standards that the manufacturer is claiming conformity with.	_____	N/A
	Where there are more than two circuits, declarations shall be made with regard to each combination of circuits.	_____	N/A
8.3.6	Insulation resistance		
	The moisture treatment is carried out in a humidity cabinet at a relative humidity of 93% ± 3% RH. The air temperature is kept at all points, where the test sample can be positioned, within ± 2 K at a suitable temperature T between 20°C and 30°C. Before putting the test samples into the humidity cabinet, they shall have a temperature between T and (T+4) in °C.		N/A
	The samples shall be kept in the humidity cabinet for 2 days (48 h).		N/A
	After a delay of between 30 min and 60 min following the humidity treatment, the insulation resistance is measured 60 s after having applied a d.c. voltage of 500 V.		N/A

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>This measurement is carried out in the humidity cabinet or in the room into which the specimens were brought to reach the determined temperature, after having refitted the parts which might have been detached.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A
	Pass criteria		
	<p>The insulation resistance shall not be lower than</p> <ul style="list-style-type: none"> • 5 MΩ for the measurements according to a), • 2 MΩ for the measurements according to b). 	<p>_____ MΩ</p> <p>_____ MΩ</p>	N/A
8.3.7	Dielectric withstand		
	SPDs classified for outdoor use are tested between the terminals with the internal parts removed. During this test, the SPD is subjected to sprinkling according to 9.1 of IEC 60060-1.		N/A
	SPDs classified for indoor are tested as indicated in a) and b) of 8.3.6.		N/A

IEC 61643-11 - TEST SEQUENCE 3a Additional tests for SPDs with separate isolated circuits			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>SPDs are tested with an a.c. voltage according to Table 9. Starting with not more than half the required a.c. voltage, this voltage is increased to the full value within 30 s which is maintained for 1 min.</p> <p>a) between all interconnected live parts of the separate circuits and the SPDs body accessible to accidental contact. The express "body" in the sense of this test means</p> <ul style="list-style-type: none"> • all touchable metal parts and a metal foil on surfaces of insulating material, which are touchable after installation as for normal use, • the surface on which the SPD is mounted, if necessary covered with metal foil, • screws and other facilities for fastening the SPD on its support <p>Fore these measurements, the metal foil is put on in such a way, that perhaps existing casting mass is effectively tested.</p> <p>Protective components connected to PE may be disconnected for this test.</p> <p>b) between each combination of separate isolated circuits of the SPD, if there is more than one.</p>		N/A
	Pass criteria		
	Arcing or puncturing shall not occur, however, partial discharges are accepted if the voltage change the discharge is less than 5%.		N/A
	The power transformer used for testing shall be designed in such a way that after having been adjusted to the test voltage at its open terminals it will generate a short-circuit current of at least 200 mA after short-circuiting the terminals. An overcurrent relay, if any, shall only react if the test circuit current exceeds 100 mA. The device for measuring the test voltage shall have a precision of $\pm 3\%$.		N/A

IEC 61643-11 - TEST SEQUENCE 3b Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.2.1/8.7.2	Test to determine the voltage drop (two port SPDs)		
	U _c supplied at the input port SPD loaded with rated load current into a resistive load Input and output voltage measured simultaneously to determine the percentage voltage regulation $\Delta U\% = ((U_{in} - U_{out}) / U_{in}) * 100\%$	_____ V _____ A _____ %	N/A
	Pass criteria		
C	No mechanical damage		N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.1.1/ 8.6.1.1	Rated load current (I_L)		
	The SPD shall be powered at a voltage $U_C^{+0/-5\%}$ at ambient temperature, using a cable with a nominal cross-section as specified in Table 19. The test shall be conducted with rated load current into a resistive load until thermal stability is reached. Additional cooling of the SPD is not permitted.	____ V ____ A ____ mm ²	N/A
	Pass criteria		
	Value complies with the manufacturers		N/A
	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
	The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in Annex G during the test. Parts of SPD: <ul style="list-style-type: none"> • Built-in components • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	Temperature rise: ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K ____ K / ____ K	N/A
7.5.1.2	Overload behaviour		
	The SPD shall be damaged or altered by overloads, which may occur in normal use.		
8.6.1.2	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	The test is carried out at ambient temperature and the sample shall be protected against abnormal external heating or cooling.		N/A
	The test circuit and procedure shall be as described in 8.6.1.1, except that circuits other than the main circuit are disregarded for this test.		N/A
	The test is performed without any external disconnectors being connected (internal removable overcurrent protective devices are replaced by a link of negligible impedance).		N/A
	If a maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to k times that maximum overcurrent protection. The factor k shall be selected from Table 20.	k = _____ I = _____ A	N/A
	If no maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded with 1,1 times the rated load current for 1 h or until an internal disconnector operates. If no disconnector operates within 1 h, the test is continued by increasing the previous value of test current by a factor of 1,1 every hour, until an internal disconnector operates.	_____ A 1h → _____ A 1h → _____ A	N/A
	Pass criteria		
	The temperature rise of surfaces which are accessible in normal use shall not exceed the values described in ANNEX G during the test. Parts of SPD: <ul style="list-style-type: none"> • Built-in SPD: • Terminals for external insulated conductors • Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars • Manual operating means of metal • Manual operating means of insulating material • Accessible external enclosures and covers <ul style="list-style-type: none"> – metal surfaces – insulating surfaces • Discrete arrangements of plug and socket-type connections 	Temperature rise: _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K _____ K / _____ K	N/A

IEC 61643-11 - TEST SEQUENCE 3c			
Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
	a) Any internal disconnecter has operated:		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	____ V ____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	____ mA	N/A
M	There shall be no explosion or other hazard to either personnel or the facility.		N/A
	b) No internal disconnecter has operated:		
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq$ ____ V	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	____ kA / ____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	____ kA / ____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	____ kA / ____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P	____ kV	N/A

IEC 61643-11 - TEST SEQUENCE 3c Additional tests for two-port SPDs with separate input / output terminals			
Clause	Requirement - Test	Result - Remark	Verdict
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_C = \text{_____ V}$ test voltage _____ V	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
7.4.2/8.5.2	Heat resistance		
	The SPD is kept in a heated cabinet at a temperature of 100 °C ± 2 K for the duration of 1 h.		P
	Pass criteria		
C	No mechanical damage		P
I	SPDs having an IP degree ≥ IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
	Any sealing compound (including potting) used in the internal assembly shall not move to such an extent as to create a problem for the functionality of the SPD.		N/A
	The SPD is deemed to have passed the test even if a disconnecter has opened.		P
7.2.8	Behaviour under temporary overvoltages		
	SPDs for TT-systems between neutral and PE upstream the main RCD shall pass the TOV withstand mode criteria given 8.3.8.2.		N/A
7.2.8.1/8.3.8.1	TOVs caused by faults or disturbances in the low voltage system		
	For SPDs with a U_C greater than or equal to U_T there is no need to perform this test	_____	N/A
	SPDs shall be tested using either the <ul style="list-style-type: none"> • TOV voltages U_T given in the relevant tables of Annex B, or, <ul style="list-style-type: none"> • TOV voltages stated by the manufacturer according to 7.1.1 c1), whichever values are higher.	For fault in consumer installation condition: $U_T = \underline{337\text{ V}}$ For fault in distribution system and loss of neutral condition: $U_T = \underline{442\text{ V}}$	P
	Table B.1 shall be applied to all SPDs Depending on the information given by the manufacturer on 7.1.1 c1), the additional tables according to Clause B.1 of Annex B shall also be applied. For North American systems – Table B.2 For Japanese systems – Table B.3		P under consideration

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions		P
	The test sample shall be connected to a power frequency voltage of $U_T^{+0/-5}$ % for a duration $t_T^{+5/-0}$ %.		P
	Except for loss of neutral tests, this power source for U_T , shall be capable of delivering a current high enough to ensure that the voltage at the SPD terminals does not fall below U_T by more than 5 % during the test. For loss of neutral tests this voltage source shall be capable of delivering a prospective short-circuit current of 10A.		P
	Immediately following the application of U_T , a voltage equal to $U_{REF}^{+0/-5}$ % with the same current capability, shall be applied to the test sample for a period of 15 min $^{+5/-0}$ %.	$U_{REF} = 255$ V	P
	For loss of neutral tests, this power source for U_{REF} shall be capable of delivering a prospective short-circuit current equal to the declared short-circuit current rating of the SPD.		P
	The time interval between the test periods shall be as short as possible and shall in any case not exceed 100 ms.		P
a)	Pass criteria TOV failure mode		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnectors.		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
b)	Pass criteria TOV withstand mode		
A	Thermal stability shall be achieved		P
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		P
C	No mechanical damage		P
D	Determination of the measured limiting voltage:	$U_p \leq 2,0 \text{ kV}$	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	For fault in consumer installation condition: Max. 1,7 kV For fault in distribution system and loss of neutral condition: Max. 1,8 kV	P
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_{REF} = 255 \text{ V}$</p> <p><1 mA</p>	P
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>		N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	<p>$U_C = 250 \text{ V}$</p> <p><1 mA</p>	P
F	External disconnectors shall not operate during the test and shall be in working order after the test.		N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
L	The tissue paper shall not catch fire.		P
M	There shall be no explosion or other hazard to either personnel or the facility		P

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.8.2/8.3.8.2	TOVs caused by faults in the high (medium) voltage system		
	SPDs connected to PE and for use on power distribution systems <ul style="list-style-type: none"> • TOV voltages U_T given in Annex B or, <ul style="list-style-type: none"> • TOV voltages stated by the manufacturer according to 7.1.1 c1) whichever values are higher.	$U_T = \underline{\hspace{2cm}} \text{ V}$ $U_T = \underline{\hspace{2cm}} \text{ V}$	N/A
	Table B.1 shall be applied to all SPDs Depending on the information given by the manufacturer on 7.1.1 c1), the additional tables according to Clause B.1 of Annex B shall also be applied. For North American systems – Table B.2 For Japanese systems – Table B.3	under consideration	N/A
	New samples shall be used and fitted as in normal use, according to the manufacturer's instructions, and connected to a test circuit according to Figure 16 or equivalent		N/A
	The test voltage $U_T^{+0/-5\%}$ is applied to the test sample at 90 electrical degrees of phase L1 by closing switch S1.		N/A
	After the TOV application time $t_T^{+0/-5\%}$ switch S2 is closed automatically. This connects the SPD's PE-terminal to the neutral.		N/A
	Test circuit according to Figure 16 and Figure 17 or, alternative test circuit given in Annex E. Other test circuits are permitted as long as they ensure the same stress to the SPD.	<u> </u>	N/A
	The prospective short-circuit current of the power source for U_{REF} shall be equal to five times the rated current of the maximum overcurrent protection is declared. The tolerance for the current is $^{+10}/_{-0}\%$.	<u> </u> A	N/A
	The prospective short-circuit current delivered by the TOV transformer shall be adjusted to $300A^{+10}/_{-0}\%$ by R2.	<u> </u> A	N/A
	With the exception of SPDs connected neutral to ground, U_{REF} remains applied to the test sample for 15 min without interruption until switch S1 is reopened.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
a)	Pass criteria TOV failure mode		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	____ V ____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	____ mA	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
b)	Pass criteria TOV withstand mode		
A	Thermal stability shall be achieved		N/A
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_P \leq$ ____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	____ kA / ____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	____ kA / ____ V	N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} =$ _____ V	N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	$U_C =$ _____ V test voltage _____ V	N/A
	For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C . Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C =$ _____ V $I_{PE} =$ _____ mA	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A

IEC 61643-11 - TEST SEQUENCE 4			
Clause	Requirement - Test	Result - Remark	Verdict
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
L	The tissue paper shall not catch fire.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
7.2.5.3	Short-circuit current behaviour		
8.3.5.3	This test is not applied to SPDs which are either <ul style="list-style-type: none"> classified for outdoor use and for mounting out of reach, for connection N-PE in TN and/or TT systems only 		N/A
	The test sample shall be mounted in accordance with the manufacturer's published recommendations and connected with conductors of the maximum cross section according to 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		P
	Sample preparation		
	For SPDs with non-linear components connected in parallel, separate sets of three samples shall be prepared in the manner below for every current path of the SPD which contains one or more non-linear component in 3.1.4 and 3.1.5.		P
	Current paths containing voltage switching components with combined disconnecter function, having an impulse withstand voltage equal or greater than 6 kV and a dielectric withstand equal or greater than 2500 V/50 Hz for 1 min in normal operating condition, are tested without any preparation and only in conjunction with other current paths prepared in the manner described below. Voltage limiting components and voltage switching components described in 3.1.4 and 3.1.5 shall be replaced by appropriate copper blocks (dummies) ensuring that the internal connections and their cross-section and surrounding material (e.g. resins) and packaging are not changed.		P
	a) Test at the declared short-circuit current rating		
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	<u>255</u> V <u>3,0</u> kA $\cos \varphi = \underline{0,95}$	P
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		P
	If a replaceable or resettable internal or external disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
C	No mechanical damage		P
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	<1 mA	P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		P
M	There shall be no explosion or other hazard to either personnel or the facility		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , having a prospective short-circuit current of five times the rated current of the maximum overcurrent protection (if declared by the manufacturer), and a power factor according to Table 8, shall be applied for $5\text{ s} \pm 0,5\text{ s}$. If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used.	<u>255</u> V <u>0,3</u> kA $\cos \varphi = \underline{0,95}$	P
	The test is carried out once with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		P

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
C	No mechanical damage		P
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		P
M	There shall be no explosion or other hazard to either personnel or the facility.		P
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		P
	If disconnection occurs during the test:		
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		P
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.		P
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		P
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.		P
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		P
8.3.5.3.1	Additional test for SPDs with I_{fi} lower than the declared short-circuit current rating (I_{SCCR})		
	This test is only performed if the declared follow current interrupt rating I_{fi} is smaller than the test current.		N/A
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	<p style="text-align: right;">_____ V</p> <p style="text-align: right;">_____ kA</p> <p style="text-align: right;">cos φ= _____</p>	N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	The voltage switching component(s) of the SPD is triggered with a positive surge current (8/20 or other appropriate waveshape) at (35 ± 5) electrical degrees after the zero crossing of the voltage on the positive half wave. The surge current shall be high enough to initiate a follow current but shall in no case exceed I_n . The test is carried out twice.		N/A
	To ensure that no external disconnecter operates due to the trigger surge, all external disconnectors shall be placed in series with the power frequency source as shown in Figure 11.		N/A
	If a replaceable or resettable internal disconnecter operates, the relevant disconnecter shall be replaced or reset each time. If the disconnecter cannot be replaced or reset, the test is stopped.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnecter(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	____ V ____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	____ mA	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnecter(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
8.3.5.3.2	Additional test for SPD's failure mode simulation		
	For this test any electronic indicator circuitry may be disconnected.		N/A
	New samples shall be used and fitted as in normal use, acc. to the manufacturer's instructions and connected with conductors of the maximum cross section acc. to 8.4.2. The maximum length of the cables connection the sample shall be of 0,5 m each.		N/A
	External disconnectors, if recommended by the manufacturer, shall be used.	_____	N/A
	The test sample shall be connected to a power frequency voltage source at the following conditioning voltages: <ul style="list-style-type: none"> • SPDs rated U_C up to 440V, apply a voltage equal to $1200 V_{rms}^{+5/-0\%}$ • SPDs with U_C rated above 440V, apply a voltage equal to 3 times $U_C^{+5/-0\%}$ 	_____ V	N/A
	The conditioning voltage is applied for a duration of $5 s^{+5/-0\%}$. The prospective short-circuit current of this power source for conditioning shall be adjusted to a value between 1 A and $20 A_{rms}^{+5/-0\%}$, as provided by the manufacturer according to 7.1.1 d5).	_____ A	N/A
	Following the application of the conditioning voltage equal to $U_{REF}^{+0/-5\%}$ with a short-circuit current capability as given below, shall be applied to the sample for a period of $5 min^{+5/-0\%}$ or for at least 0,5 s after interruption of the current by an internal or external disconnector.		N/A
	The transition from conditioning voltage application to U_{REF} application shall be performed without interruption. The current flow through the SPD shall be monitored. An appropriate test circuit and timing diagram is shown in Figure 12 and Figure 13.		N/A
	The prospective short-circuit current of the power source at U_{REF} shall have a tolerance of $+5/-0\%$ at the location where the SPD is connected. The power factor of the power source shall comply with Table 8.		N/A
	Each of the following tests shall be performed on a new set of three preconditioned samples as above at U_{REF} with a short-circuit current of 100A, 500A and 1000A, respectively, unless these values exceed the declared short-circuit rating of the SPD.	_____ A	N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	A further test shall be performed on three preconditioned samples as above and at U_{REF} with a prospective short-circuit current equal to the manufacturer's declared short-circuit current rating. For this test, the time interval between the completion of the conditioning test and the application of U_{REF} shall be as short as possible and shall not exceed 100 ms.		N/A
	If all oscillograms of the tests on the first set of samples (100 A test set up) show a disconnection within 5 s during the application of the conditioning voltage, no further test is performed.		N/A
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		
C	No mechanical damage		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
	Additional pass criteria except for: <ul style="list-style-type: none"> • short circuiting type SPDs • SPDs where the current is interrupted during the application of U_{REF} where no disconnection occurs.		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
J	If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s). If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.	_____ V _____ mA	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A

IEC 61643-11 - TEST SEQUENCE 5			
Clause	Requirement - Test	Result - Remark	Verdict
	Current through the PE-terminal shall not exceed 1mA If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.	_____ mA	N/A

IEC 61643-11 - TEST SEQUENCE 6 Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
7.6.1.1/8.7.1	Total discharge current test for multipole SPDs		
	One side of the test generator is connected to the PE or PEN terminal of the multipole SPD. Each of the remaining SPD terminals is connected via a typical series impedance consisting of a resistance of 30 mΩ and an inductance of 25 μH, to the other side of the generator. Smaller impedances may be used if the tolerances for the proportional surge currents according to Table 21 are met.		N/A
	The multipole SPD shall be tested once with the total discharge current I_{Total} declared by the manufacturer.	_____ kA	N/A
	Pass criteria		
B	Voltage and current records and visual inspection show no sign of puncture or flashover.		N/A
C	No mechanical damage		N/A
D	Determination of the measured limiting voltage:	$U_p \leq$ _____ V	
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	_____ kA / _____ V	N/A
	according to 8.3.3.1, but only at I_n for test class II	_____ kA / _____ V	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	_____ kA / _____ V	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_p	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A

IEC 61643-11 - TEST SEQUENCE 6 Additional tests if declared by the manufacturer			
Clause	Requirement - Test	Result - Remark	Verdict
	<p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}).</p> <p>The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	<p>Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater.</p> <p>During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.</p>	$U_C = \text{_____ V}$ test voltage _____ V	N/A
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> • shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.2/8.6.2	Environmental tests for outdoor SPDs (informative)		
F.1	Accelerated aging test with UV radiation		
	Expose three complete SPDs, as to be installed for outdoor use, to 1000 h of UV radiation (UV-B) and water spray as follows: 500 cycles of 120 min each, consisting of 102 min of UV light at 60 °C, 18 min of UV light and water spray at 65 °C and 65 % RH. The UV radiation shall be according to ISO 4892-2, method A. ISO 4892-1 and ASTM 151 are to be used for general guidance for the test.		N/A
	The samples shall be connected to a power source at U_C during the test and residual current shall be monitored at 120 min intervals. After completion of this test, the samples shall be tested according to F.2.		N/A
	Pass criteria		
	During and after the test the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10%. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A
F.2	Water immersion test		
	The test is performed in accordance with Figure 8 of IEC 60099-4. The test samples shall kept immersed in a vessel, in boiling de-ionized water with 1 kg/m ³ of NaCl, for 42 h.		N/A
	At the end of boiling, the SPD shall remain in the vessel until the water has cooled down to approximately 20 °C (\pm 15 °C) and shall be maintained in the water till the verification tests are performed. After the water immersion test the samples shall be subjected the dielectric test (see F.3).		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
F.3	Dielectric test		
	<p>The test samples shall be subjected to a dielectric test at a power frequency sinusoidal voltage of 1000 V plus twice the reference test voltage U_{REF} for 1 min and the leakage current shall be measured. The test voltage shall be applied as follows:</p> <p>a) SPD with metallic housing with or without mounting bracket The voltage shall be applied between all terminals or external leads which are not internally connected to the housing, neither directly nor through surge protective components, connected together, and the metallic housing. If all terminals and external leads are connected directly or through components to the conductive housing, this test is not performed.</p> <p>b) SPD with non-conductive housing with non-conductive or without mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead or terminal. The voltage shall be applied between the conductive foil and all terminals or external leads connected together.</p> <p>c) SPD with non-conductive housing with metallic mounting bracket The non-conductive housing shall be tightly wrapped in conductive foil to within 15 mm of any non-insulated lead, terminal and the metallic mounting bracket. The voltage shall be applied between the conductive foil and all terminals, external leads and mounting bracket connected together.</p>		N/A
	Pass criteria		
	The leakage current measured during this test shall not exceed 25 mA.	$I = \underline{\hspace{2cm}}$ mA	N/A
F.4	Temperature cycle test		
	The test shall be performed according to IEC 60068-2-14 with 5 cycles with a lower temperature of -40 °C and with an upper temperature of +100 °C. The time duration for each half cycle is 3 h and the temperature change shall occur within 30 s.		N/A

IEC 61643-11 - TEST SEQUENCE 7 Additional tests for outdoor use SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
	Pass criteria		
	During and after the test, the samples shall be visually inspected for voids, cracks, tracking and surface erosion. The residual currents shall not increase by more than 10 %. The degree of tracking, surface erosion and cracking shall be assessed to determine if this will compromise the enclosure of the product to meet the other electrical and mechanical performance requirements of this standard.		N/A
F.5	Verification of resistance to corrosion		
	<p>SPDs with exposed metal parts shall be subjected to the test and shall be mounted as for normal use according to the manufacturer's instructions.</p> <p>The enclosure or samples shall be new and in a clean condition. The samples shall be subjected to the following test:</p> <ul style="list-style-type: none"> • 12 cycles of 24 h, damp heat cycling test according to test Db of IEC 60068-2-30 at 40 °C and relative humidity of 95 %; • 14 cycles of 24 h, salt mist test according to test Ka of IEC 60068-2-11 at a temperature of (35 ± 2) °C. <p>After the test, the samples shall be washed in running tap water for 5 min, rinsed in distilled or demineralized water then shaken or subjected to air blast to remove water droplets. The specimen under test shall then be stored under normal service conditions for 2 h.</p>		N/A
	Pass criteria		
	<p>Compliance is checked by visual inspection to ensure that:</p> <ul style="list-style-type: none"> • there is no evidence of rust, cracking or other deterioration. However, surface deterioration of any protective coating is allowed. In case of doubt, reference shall be made to ISO 4628-3 to verify that the samples conform to the specimen Ri1; • seals are not damaged; • any moving parts (disconnectors) work without abnormal effort. 		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
7.5.4/8.6.4	Short-circuiting type SPDs		
	<p>These SPDs shall be capable of withstanding a short-circuit current test at their declared short-circuit current rating after having been overstressed by a surge current according to their transition rating I_{trans}.</p> <p>For such SPD's a conditioning into an intentional short-circuit according 8.6.4.1 is carried out, followed by a surge withstand test according 8.6.4.2 and a short-circuit current behaviour test according 8.6.4.3.</p>		N/A
8.6.4.1	Change of characteristic procedure (conditioning test)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD to change of characteristic of the SPD into an internal short-circuit. To check for the internal short-circuit an appropriate measurement shall be performed after this test.	$I_{trans} = \text{_____ kA}$	N/A
8.6.4.2	Surge withstand test (in short-circuited condition)		
	One impulse of I_{trans} with positive polarity is applied to the de-energised SPD.		N/A
	Pass criteria		
C	No mechanical damage		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
8.6.4.3	Short-circuit current behaviour test (in short-circuited condition)		
	The test is performed according to 8.3.5.3 excluding 8.3.5.1 and 8.3.5.3.2, but without any sample preparation.		N/A
8.3.5.3	<p>This test is not applied to SPDs which are either</p> <ul style="list-style-type: none"> • classified for outdoor use and for mounting out of reach, • for connection N-PE in TN and/or TT systems only 		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
	The test sample shall be mounted in accordance with the manufacturer's published recommendations and connected with conductors of the maximum cross section according to 8.4.2, keeping the cables connecting the sample to a maximum length of 0,5 m each.		N/A
	a) Test at the declared short-circuit current rating		
	The sample is connected to a power frequency source at U_{REF} . The prospective short-circuit current as declared by the manufacturer and with the corresponding power factor as given in Table 8 are adjusted at the SPD terminals.	<p>_____ V</p> <p>_____ kA</p> <p>cos φ= _____</p>	N/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees and at (90 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	If a replaceable or resettable internal or external disconnector operates, the relevant disconnector shall be replaced or reset each time. If the disconnector cannot be replaced or reset, the test is stopped.	_____	N/A
	b) Test at low short-circuit current		
	A power frequency source at U_{REF} , having a prospective short-circuit current of five times the rated current of the maximum overcurrent protection (if declared by the manufacturer), and a power factor according to Table 8, shall be applied for $5 \text{ s} \pm 0,5 \text{ s}$. If no external overcurrent protection is required by the manufacturer, a prospective short-circuit current of 300 A is used.	<p>_____ V</p> <p>_____ kA</p> <p>cos φ= _____</p>	N/A
	The test is carried out twice with U_{REF} applied at (45 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
	Pass criteria		
C	No mechanical damage		N/A
H	Disconnection shall be provided by one or more internal or external disconnector(s). Their correct indication shall be checked.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A

IEC 61643-11 - TEST SEQUENCE 8 Additional tests for short-circuiting type SPDs			
Clause	Requirement - Test	Result - Remark	Verdict
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_____ V</p> <p>_____ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	_____ mA	N/A
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A

Remarks:

Table 3 – Type test requirements for SPDs

Test sequence	Test description	Subclause requirement/test	External disconnectors connected ^a	Tissue paper used	Metallic screen used	Test class I	Test class II	Test class III
1	Identification and marking	7.1.1/7.1.2/8.2	-	-	-	A	A	A
	Mounting	7.3.1	-	-	-	A	A	A
	Terminals and connections	7.3.2/7.3.3/8.4.2	-	-	-	A	A	A
	Testing for protection against direct contact	7.2.1/8.3.1	-	-	-	A	A	A
	Environment, IP code	7.4.1 / 8.5.1	-	-	-	A	A	A
	Residual current	7.2.2 / 8.3.2	-	-	-	A	A	A
	Operating duty test	7.2.4/8.3.4 ^b						
	Operating duty test for test classes I, II or III	8.3.4.2 / 8.3.4.3/ 8.3.4.5	A	-	-	A	A	A
	Additional duty test for test class I	8.3.4.4	A	-	-	A	-	-
	Thermal stability	7.2.5.2 / 8.3.5.2	A	-	-	A	A	A
	Air clearances and creepage distances	7.3.4 / 8.4.3	-	-	-	A	A	A
	Ball pressure test	7.4.2 / 8.5.3	-	-	-	A	A	A
	Resistance to abnormal heat and fire	7.4.3 / 8.5.4	-	-	-	A	A	A
	Tracking resistance	7.4.4 / 8.5.5	-	-	-	A	A	A
2	Voltage protection level	7.2.3/8.3.3						
	Residual voltage	8.3.3.1	-	-	-	A	A	-
	Front of wave sparkover voltage	8.3.3.2	-	-	-	A	A	-
	Limiting voltage with combination wave	8.3.3.3	-	-	-	-	-	A
2a	See below - only if applicable							
2b	See below - only if applicable							
3	Insulation resistance	7.2.6 / 8.3.6	-	-	-	A	A	A
	Dielectric withstand	7.2.7 / 8.3.7	-	-	-	A	A	A
3a	See below - only if applicable							
	Mechanical strength	7.3.5 / 8.4.4	-	-	-	A	A	A
	Temperature withstand	7.2.5 / 8.3.5.1 ^b	-	-	-	A	A	A
3b ^c	See below - only if applicable							
3c	See below - only if applicable							
4 ^c	Heat resistance	7.4.2 / 8.5.2	-	-	-	A	A	A
	TOV tests	7.2.8 / 8.3.8						
	TOVs caused by faults or disturbances in the low voltage system	7.2.8.1/8.3.8.1 ^b	A	A	-	A	A	A
	TOVs caused by faults in the high (medium) voltage system	7.2.8.2/8.3.8.2 ^b	A	A	-	A	A	A
5 ^c	Short-circuit current behaviour	7.2.5.3 / 8.3.5.3	A	-	A	A	A	A

Table 3 – Type test requirements for SPDs (continued)

Additional tests for specific SPD designs								
Test sequence	Test description	Subclause requirement/test	External disconnectors connected ^a	Tissue paper used	Metallic screen used	Test class I	Test class II	Test class III
Additional tests for two-port SPDs and one port-SPDs with separate input / output terminals								
3c ^c	Rated load current	7.5.1.1 / 8.6.1.1	A	-	-	A	A	A
	Overload behaviour	7.5.1.2 / 8.6.1.2 ^b	-	-	-	A	A	A
2b	Load side short-circuit current behaviour	7.5.1.3 / 8.6.1.3 ^b	A	-	A	A	A	A
Additional tests if declared by the manufacturer								
3b	Voltage drop	7.6.2.1 / 8.7.2	-	-	-	A	A	A
2a ^c	Load side surge withstand	7.6.2.2 / 8.7.3 ^b	A	-	-	A	A	A
6	Total discharge current test for multipole SPDs	7.6.1.1 / 8.7.1 ^b	-	-	-	A	A	-
Additional tests for outdoor use SPDs								
7	For SPDs classified "outdoor"	7.5.2 / 8.6.2	-	O	-	A	A	-
Additional tests for SPDs with separate isolated circuits								
3a	Isolation between separate circuits	7.5.3/ 8.3.6 / 8.3.7	-	-	-	A	A	A
Additional tests for short-circuiting type SPDs								
8	Change of characteristic procedure (preconditioning to short-circuited condition)	7.5.4 / 8.6.4	-	-	-	-	A	-
	Surge withstand test (in short-circuited condition)	7.5.4 / 8.6.4	-	-	-	-	A	-
	Short-circuit current behaviour (in short-circuited condition)	7.5.4 / 8.6.4	A	-	A	-	A	-
<p>A = applicable</p> <p>- = not applicable</p> <p>O = optional</p> <p>^a external disconnectors connected means that all disconnectors as specified by the manufacturer shall be tested with the SPD during the type tests, except for RCDs, which are not tested during the operating duty test according to 8.3.4.</p> <p>^b For these tests initial measurements of leakage currents according to Table 4, pass criterion E may be necessary.</p> <p>^c For this test sequence more than one set of samples may be needed.</p>								

Table 4 – Common pass criteria for type tests

A	Thermal stability shall be achieved. The SPD is considered to be thermally stable if the crest of the resistive component of the current flowing into the SPD or the power dissipation shows either a decreasing tendency or does not increase during 15 min of U_C voltage application immediately after the application of U_C . If the test itself is performed with the SPD energized at U_C , then U_C either remains applied for these 15 min without interruption or is reapplied within less than 30 s.
B	Voltage and current records and visual inspection shall show no indication of puncture or flashover.
C	No visible damage shall occur during the test. After the test, small indents and cracks not impairing the protection against direct contact are disregarded during this check, unless the degree of protection (IP-code) given for the SPD is no longer provided. There shall be no visual evidence of burning of the sample after the test.
D	Values for measured limiting voltage after the test shall be below or equal to U_P . The measured limiting voltage shall be determined, using the tests described in 8.3.3, but the test of 8.3.3.1 is performed only with a 8/20-surge current with a crest value of I_{imp} for Test Class I or with I_n for Test Class II or with the test of 8.3.3.3 but only at U_{OC} for Test class III.
E	<p>No excessive leakage currents shall occur after the test.</p> <p>The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA, or the current shall not have changed by more than 20 % compared to the initial value determined at the beginning of the relevant test sequence.</p> <p>Any resettable or rearmable disconnecter shall be switched off manually, if applicable, and the dielectric withstand shall be checked by application of two times U_C or 1 000 V a.c., whichever is greater. During the test, no flashover, breakdown of insulation either internally (puncture) or externally (tracking) or any other manifestation of disruptive discharge shall occur.</p> <p>In addition for SPD modes connected N-PE only the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at the maximum continuous operating voltage (U_C). Its resistive component (measured at the crest of the sine wave) shall not exceed a value of 1 mA, or the current shall not have changed by more than 20 % compared to the initial value determined at the beginning of the relevant test sequence.</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>
F	External disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test. For the purpose of this clause, working order means that there is no damage to the disconnector and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.
G	Internal disconnectors as specified by the manufacturer shall not operate during the test and shall be in working order after the test. For the purpose of this clause, working order means that there is no damage of the disconnector and that it is still operational. Operation can be checked either manually (where possible) or by a simple electrical test agreed between the manufacturer and the laboratory.
H	Disconnection shall be provided by one or more internal and/or external disconnector(s). Their correct indication shall be checked.
I	SPDs with an IP degree equal to, or greater than, IP20 shall not have live parts accessible with the standardized test finger applied with a force of 5 N (see IEC 60529), except the live parts which were already accessible before the test when the SPD is fitted as in normal use.
J	<p>If disconnection (internal or external) occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected as for normal use at the maximum continuous operating voltage U_C and at rated frequency for 1 min. The test source shall have a short-circuit current capability equal or greater than 200 mA. The current that flows through the relevant protective components shall not exceed a value of 1 mA.</p> <p>Currents through components connected in parallel to the relevant protective component(s), or otherwise connected (e.g. indicator circuits), are disregarded for this measurement, as long as they cannot cause a current through the relevant protective component(s).</p> <p>In addition the current through the PE-terminal, including parallel circuits and other circuits (e.g. indicator circuits), if any, shall not exceed 1 mA.</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>
K	The short-circuit current from the power source, if any, shall be interrupted within 5 s by one or more internal and/or external disconnector(s).
L	The tissue paper shall not catch fire.
M	There shall be no explosion or other hazard to either personnel or the facility.
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.
O	<p>After completion of this test the samples shall be allowed to return to room temperature and be connected to a power source at U_C for 2 h.</p> <p>The residual current shall be monitored and not exceed the value measured at the beginning of the test by more than 10 %.</p>

Table 8 – Prospective short-circuit current and power factor

I_p (kA) $\begin{matrix} +5 \\ 0 \end{matrix}$ %	$\cos \varphi$ ($\begin{matrix} 0 \\ -0,05 \end{matrix}$)
$I_p \leq 1,5$	0,95
$1,5 < I_p \leq 3,0$	0,9
$3,0 < I_p \leq 4,5$	0,8
$4,5 < I_p \leq 6,0$	0,7
$6,0 < I_p \leq 10,0$	0,5
$10,0 < I_p \leq 20,0$	0,3
$20,0 < I_p \leq 50,0$	0,25
$50,0 < I_p$	0,2
NOTE Recovery voltage according to IEC 60947-1.	

Table 10 – Screw thread diameters and applied torques

Nominal diameter of thread mm	Torque Nm		
	I	II	III
Up to and including 2,8	0,2	0,4	0,4
Over 2,8 up to and including 3,0	0,25	0,5	0,5
Over 3,0 up to and including 3,2	0,3	0,6	0,6
Over 3,2 up to and including 3,6	0,4	0,8	0,8
Over 3,6 up to and including 4,1	0,7	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0	2,0
Over 5,3 up to and including 6,0	1,2	2,5	3,0
Over 6,0 up to and including 8,0	2,5	3,5	6,0
Over 8,0 up to and including 10,0	–	4,0	10,0

Table 11 – Cross-sections of copper conductors for screw-type or screwless terminals

Maximum continuous load current for two-port SPDs or one-port SPDs with separate input/output terminals ^a A	Range of nominal cross-sections to be clamped (single conductor)	
	mm ²	American Wire Gauge
Up to and including 13	1 to 2,5	18 to 14
Above 13 up to and including 16	1 to 4	18 to 12
Above 16 up to and including 25	1,5 to 6	16 to 10
Above 25 up to and including 32	2,5 to 10	14 to 8
Above 32 up to and including 50	4 to 16	12 to 6
Above 50 up to and including 80	10 to 25	8 to 3
Above 80 up to and including 100	16 to 35	6 to 2
Above 100 up to and including 125	25 to 50	4 to 1

^a It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors; the use of flexible conductors is permitted.

Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm² up to 6 mm² be designed to clamp solid conductors only.

Table 12 – Pulling forces (screw terminals)

Cross-section of conductor accepted by the terminal mm ²	Up to 4	Up to 6	Up to 10	Up to 16	Up to 50
Pull N	50	60	80	90	100

Table 13 – Conductor dimensions

Range of nominal cross-sections to be clamped mm ²	Stranded conductor
	Number of wires
1 to 2,5 ^a	7
1 to 4 ^a	7
1,5 to 6 ^a	7
2,5 to 10	7
4 to 16	7
10 to 25	7
16 to 35	19
25 to 50	Under consideration

^a If the terminal is intended to clamp solid conductors only (see table footnote of Table 11), the test is not performed.

Table 14 – Pulling forces (screwless terminals)

Cross-sectional area mm ²	0,5	0,75	1,0	1,25 1,5	2,0 2,5	3,5 4	5,5 6	8,0 10	14 16	22 25	35 38
Pull force N	30	30	35	40	50	60	80	90	100	135	190

Table 15 – Air clearances for SPDs

U_{max}^a	$\leq 2\ 000\ V$	$\leq 4\ 000\ V$	$>4\ 000\ V$ up to 6 000 V	$>6\ 000\ V$ up to 8 000 V
	Air clearances in millimetres			
1) Between live parts of different polarity	1,5	3	5,5	8
2) Between live parts and				
– screws and other means to fasten a covering, having to be detached for mounting the SPD	1,5	3	5,5	8
– fastening surfaces (NOTE 2)	3	6	11	16
– screws or other means for fastening the SPD (NOTE 2)	3	6	11	16
– bodies (NOTES 1 and 2)	1,5	3	5,5	8
3) Between the metal parts of the disconnecter mechanism and				
– bodies (NOTE 1)	1,5	3	5,5	8
– screws or other means for fastening the SPD	1,5	3	5,5	8
^a This column is only applicable for SPDs with U_C lower or equal to 180 V.				
NOTE 1 For definition, see 8.3.6 a)				
NOTE 2 If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of line 1) are sufficient.				

Table 16 – Creepage distances for SPDs

r.m.s. voltage _{b, c}	Minimum creepage distances in millimetres								
	Printed wiring material		Pollution degree						
	Pollution degree		1	2			3		
	1	2		All material groups	Material group ^a			Material group ^a	
V	All material groups	All material groups, except IIIb	All material groups	I	II	III	I	II	III ^d
10	0,025	0,04	0,08	0,4	0,4	0,4	1	1	1
12,5	0,025	0,04	0,09	0,42	4,42	4,42	1,0	1,05	1,05
16	0,025	0,04	0,1	0,45	0,45	0,45	1,1	1,1	1,1
20	0,025	0,04	0,11	0,48	0,48	0,48	1,2	1,2	1,2
25	0,025	0,04	0,125	0,5	0,5	0,5	1,2	1,25	1,25
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3
40	0,025	0,04	0,16	0,56	0,8	1,1	1,4	1,6	1,8
50	0,025	0,04	0,18	0,6	0,85	1,2	1,5	1,7	1,9
63	0,04	0,063	0,2	0,63	0,9	1,25	1,6	1,8	2
80	0,063	0,1	0,22	0,67	0,95	1,3	1,7	1,9	2,1
100	0,1	0,16	0,25	0,71	1	1,4	1,8	2	2,2
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4
160	0,25	0,4	0,32	0,8	1,1	1,6	2	2,2	2,5
200	0,4	0,63	0,42	1	1,4	2	2,5	2,8	3,2
250	0,56	1	0,56	1,25	1,8	2,5	3,2	3,6	4
320	0,75	1,6	0,75	1,6	2,2	3,2	4	4,5	5
400	1	2	1	2	2,8	4	5	5,6	6,3
500	1,3	2,5	1,3	2,5	3,6	5	6,3	7,1	8
630	1,8	3,2	1,8	3,2	4,5	6,3	8	9	10
800	2,4	4	2,4	4	5,6	8	10	11	12,5
1 000	3,2	5	3,2	5	7,1	10	12,5	14	16

^a For further information on material groups refer to Table 17.

^b This voltage is
for functional insulation, the working voltage;
for basic and supplementary insulation of the circuit energized directly from the supply mains, the voltage rationalized through Table F.3a or Table F.3b of IEC 60664-1, based on the rated voltage of the equipment, or the rated insulation voltage;
for basic and supplementary insulation of systems, equipment and internal circuits not energized directly from the mains, the highest r.m.s. voltage which can occur in the system, equipment or internal circuit when supplied at rated voltage and under the most onerous combination of conditions of operation within equipment rating.

^c For the main protection circuit, this column refers to U_C .

^d Material IIIb shall not be used for application in pollution degree 3 above 630 V.

NOTE If the actual voltage differs from the values given in the table, it is allowed to interpolate values for intermediate voltages. When interpolating, linear interpolation should be used and values should be rounded to the same number of digits than the values picked from the table.

Table 17 – Relationship between material groups and classifications

Material group I	$600 \leq \text{CTI}$
Material group II	$400 \leq \text{CTI} < 600$
Material group IIIa	$175 \leq \text{CTI} < 400$
Material group IIIb	$100 \leq \text{CTI} < 175$
Relationship between material groups and classifications are according to IEC 60112 (CTI values, using solution A).	

Table 18 – Fall distances for impact requirements

Height of fall mm	Parts of enclosures to be subjected to the impacts	
	Ordinary accessory	Other accessories
100	A and B	A and B
150	C	C
200	D	D

A: parts on the front surface, including parts which are recessed.
B: parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.
C: parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.
D: parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

Table 19 – Test conductors for rated load current test

Test current [A]		Cross section	
Greater than	Less or equal	[mm ²]	AWG/MCM
0	8	1,0	18
8	12	1,5	16
12	15	2,5	14
15	20	2,5	12
20	25	4,0	10
25	32	6,0	10
32	50	10	8
50	65	16	6
65	85	25	4
85	100	35	3
100	115	35	2
115	130	50	1
130	150	50	0
150	175	70	00
175	200	95	000
200	225	95	0000
225	250	120	250
250	275	150	300
275	300	185	350
300	350	185	400
350	400	240	500

NOTE If other standardized cross-sections are used in specific countries, the next closest cross-section should be used for testing.

Table 20 – Current factor k for overload behaviour

Protective device	Trip current factor k
Circuit breaker	1,45
Fuse	1,6

NOTE 1 If the type of protective device (breaker or fuse) is not specified by the manufacturer, the test is performed with the higher k factor.

NOTE 2 For countries using other values, these values should be declared on the SPD's data sheet according to 7.1.1 c7).

NOTE 3 National condition for Japan: k is 1,25 for circuit-breaker and 1,5 for fuse.

NOTE 4 National condition for North America: k is under consideration.

Table 21 – Tolerances for proportional surge currents

Test classification	Proportional currents and tolerances
Test class I	$I_{imp(1)} = I_{imp(2)} = I_{imp(N)} = I_{Total(imp)} / N \quad 10 \%$ $Q_{(1)} = Q_{(2)} = Q_{(N)} = Q_{Total} / N \quad -10/+20 \%$ $W/R_{(1)} = W/R_{(2)} = W/R_{(N)} = W/R_{Total} / N^2 \quad -10/+45 \%$
Test class II	$I_{8/20(1)} = I_{8/20(2)} = I_{8/20(N)} = I_{Total(8/20)} / N \quad \pm 10 \%$

Table B.1 – TOV test values for systems complying with IEC 60364 series

Application	TOV test parameters		
	For $t_T=5$ s (LV-system faults in consumer installation) (requirement to 7.2.8.1 and test 8.3.8.1)	For $t_T=120$ min (LV-system faults in distribution system and loss of neutral) (requirement to 7.2.8.1 and test 8.3.8.1)	For $t_T=200$ ms (HV-system faults) (requirement to 7.2.8.2 and test 8.3.8.2)
SPDs connected to:	Withstand mode required	Withstand or safe failure mode acceptable	Withstand or safe failure mode acceptable
	TOV test values U_T (V)		
TN-systems			
Connected L-(PE)N or L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			
Connected L-L			
TT-systems			
Connected L-PE	$\sqrt{3} \times U_{REF}$	$1,32 \times U_{REF}$	$1\,200 + U_{REF}$
Connected L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			$1\,200$
Connected L-L			
IT-systems			
Connected L-PE			$1\,200 + U_{REF}$
Connected L-N	$1,32 \times U_{REF}$	$\sqrt{3} \times U_{REF}$	
Connected N-PE			$1\,200 + U_{REF}$
Connected L-L			
U_{REF}	reference test voltage used for testing and taking into account the maximum voltage regulation of the power system (see Annex A).		
U_0	in TN- and TT-systems: nominal a.c. r.m.s. line voltage to earth; in IT-systems: nominal a.c. voltage between line conductor and neutral conductor or midpoint conductor, as appropriate (see 442.1.2 of IEC 60364-4-44:2007).		
$1,32 \times U_{REF}$	U_{REF} equals $1,45 \times U_0$ in case the voltage regulation does not exceed +10 % (see 442.5 of IEC 60364-4-44:2007).		
NOTE	As voltage regulation exceeds 10 % in some countries, only U_{REF} is used in this standard for general applicability. Further information on voltage regulation can be found in IEC 60038.		

Table B.3 – TOV test parameters for Japanese systems

Application	TOV test parameters			
	LV system faults	HV system faults		
SPDs connected to:	for $t_T=120$ min	Not specified duration	for $t_T=2$ s	for $t_T=1$ s
	(LV-system faults in distribution system and loss of neutral (requirement to 7.2.8.1 and test 8.3.8.1))	Withstand or safe failure mode acceptable		
TOV test values U_T [V]				
TN systems				
Connected L-N(PE) or L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE				
Connected L-L				
TT systems				
Connected L-PE	$\sqrt{3} \times U_{REF}$	$150 + U_{REF}$	$300 + U_{REF}$	$600 + U_{REF}$
Connected L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE		150	300	600
Connected L-L				
IT systems				
Connected L-PE				$1\ 200 + U_{REF}$
Connected L-N	$\sqrt{3} \times U_{REF}$			
Connected N-PE				$1\ 200 + U_{REF}$
Connected L-L				
U_{REF}	reference test voltage used for testing and taking into account the maximum voltage regulation of the power system (see Annex A).			
NOTE 1 These values are required by ministerial ordinance of technical standards for electrical facilities.				
NOTE 2 As voltage regulation exceeds 10 % in some countries, U_{REF} is used in this standard only for general applicability. Further information on voltage regulation can be found in IEC 60038.				

Table G.1 – Temperature-rise limits

Parts of SPD	Temperature rise K
Built-in components ^a	In accordance with the relevant product standard requirements for the individual components or, in accordance with the component manufacturer's instructions ^f , taking into consideration the temperature in the SPD
Terminals for external insulated conductors	70 ^b
Busbars and conductors, plug-in contacts of removable or withdrawable parts which connect to busbars	Limited by: <ul style="list-style-type: none"> – mechanical strength of conducting material ^g; – possible effect on adjacent equipment; – permissible temperature limit of the insulating materials in contact with the conductor; – effect of the temperature of the conductor on the apparatus connected to it; – for plug-in contacts, nature and surface treatment of the contact material.
Manual operating means: <ul style="list-style-type: none"> – of metal – of insulating material 	<p style="text-align: right;">15 ^c</p> <p style="text-align: right;">25 ^c</p>
Accessible external enclosures and covers: <ul style="list-style-type: none"> – metal surfaces – insulating surfaces 	<p style="text-align: right;">30 ^d</p> <p style="text-align: right;">40 ^d</p>
Discrete arrangements of plug and socket-type connections	Determined by the limit for those components of the related equipment of which they form part ^e
<p>^a The term "built-in components" means:</p> <ul style="list-style-type: none"> – conventional switchgear and controlgear; – electronic sub-assemblies (e.g. rectifier bridge, printed circuit); – parts of the equipment (e.g. regulator, stabilized power supply unit, operational amplifier). <p>^b An SPD used or tested under installation conditions may have connections, the type, nature and disposition of which will not be the same as those adopted for the test, and a different temperature rise of terminals may result. Where the terminals of the built-in component are also the terminals for external insulated conductors, the lower of the corresponding temperature-rise limits shall be applied.</p> <p>^c Manual operating means within SPDs which are only accessible after the SPD has been opened, for example draw-out handles which are operated infrequently, are allowed to assume a 25 K increase on these temperature-rise limits.</p> <p>^d Unless otherwise specified, in the case of covers and enclosures, which are accessible but need not be touched during normal operation, a 10 K increase on these temperature-rise limits is permissible.</p> <p>^e This allows a degree of flexibility in respect of equipment (e.g. electronic devices) which is subject to temperature-rise limits different from those normally associated with switchgear and controlgear.</p> <p>^f For temperature-rise tests according to 8.6.1.1, the temperature-rise limits shall be specified by the manufacturer of the SPD.</p> <p>^g Assuming all other criteria listed are met, a maximum temperature rise of 105 K for bare copper busbars and conductors shall not be exceeded. The 105 K relates to the temperature above which annealing of copper is likely to occur.</p>	

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
ATTACHMENT TO TEST REPORT IEC 61643_11B EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES (Low-voltage surge protective devices- Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods)			
Differences according to.....: EN 61643-11:2012			
Attachment Form No.....: EU_GD_IEC61643_11B			
Attachment Originator: OVE			
Master Attachment .: Date (2012-12)			
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GENELEC COMMON MODIFICATIONS (EN)			
IEC 61643-11 - TEST SEQUENCE 1			
Clause	Requirement - Test	Result - Remark	Verdict
7.1.1/7.1.2	Identification and Marking		P
	<u>Markings on the body or permanently attached to</u>		P
	a4) The SPD type and discharge parameters for each mode of protection declared by the manufacturer and printed next to each other: <u>For Type 1:</u> "Type 1" and "I _{imp} " and the value in kA, and/or "T1" (T1 in a square) and "I _{imp} " and the value in kA <u>For Type 2:</u> "Type 2" and "I _n " and the value in kA, and/or "T2" (T2 in a square) and "I _n " and the value in kA <u>For Type 3:</u> "Type 3" and "U _{OC} " and the value in kV, and/or "T3" (T3 in a square) and "U _{OC} " and the value in kV	_____ kA _____ kA _____ kA	N/A P
	b14) I _{max} (if declared by the manufacturer)	_____	N/A
7.2.2	Residual current I_{PE}		P
	This test is not performed on SPDs for connection N-PE only		P
	For all SPDs with a terminal for the protective conductor, the residual current I _{PE} shall be measured when all SPD terminals are connected to a power supply at the reference test voltage (U _{REF}) according to the manufacturer's instructions.		P

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
8.3.2	<p>All modes of protection of the SPD shall be connected as for normal use according to the manufacturer's instructions.</p> <p>The line to PE voltage of the supply system shall be adjusted to the reference test voltage U_{REF}.</p>	<p>U_{REF} <u>255V</u></p> <p>I_{PE} <u>0,05(Max.)</u></p>	P
7.2.4/8.3.4	Operating duty		P
	<p>The SPD shall be capable of withstanding specified discharge currents during application of the maximum continuous operating voltage U_C without unacceptable changes in its characteristics.</p> <p>In addition voltage switching type SPDs or combination type SPDs shall be able to interrupt any follow current up to the short-circuit current rating (I_{scsr})</p> <p>The test setup shall comply with the circuit diagram given in Figure 7.</p>		P
8.3.4.2.2	<p>SPDs with follow current > 500A:</p> <p>The test sample shall be connected to a power frequency voltage at U_C with a prospective short-circuit current equal to the short circuit current rating I_{scsr} declared by the manufacturer and with a power factor in accordance with Table 8, except for SPDs which are only connected between neutral and protective earth in TT- and/or TN-systems, for which the prospective short-circuit current shall be at least 100A.</p>	<p>_____ kA</p> <p>$\cos \varphi =$ _____</p>	N/A
7.3.4/8.4.3	Verification of air clearances and creepage distances		P
	<p>The air clearances and creepage distances shall not be smaller than the values indicated in Table 15 and Table 16, whereby Table 16 shall be applied to items 1), 2) and 3) according to Table 15.</p>		P

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>Creepage distances in millimetres</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>Printed wiring material</p> <ul style="list-style-type: none"> – r.m.s. voltage – Material group – Pollution <p>1) Between live parts of different polarity</p> <p>2) Between live parts and</p> <ul style="list-style-type: none"> – screws and other means to fasten a covering, having to be detached for mounting the SPD – fastening surfaces (note 2) – screws or other means for fastening the SPD (note 2) – bodies (notes 1 and 2) <p>3) Between the metal parts of the disconnecter mechanism and</p> <ul style="list-style-type: none"> – bodies (note 1) – screws or other means for fastening the SPD <p>NOTE 1 – Definition see 8.3.6 a)</p>	<p style="text-align: center;"><u>250</u></p> <p style="text-align: center;"><u>IIIa</u></p> <p style="text-align: center;"><u>2</u></p> <p>required / measured</p> <p>3mm / >3mm (by gauge)</p> <p>3mm / >3mm (by gauge)</p> <p>6mm / >6mm (by gauge)</p> <p>3mm / >3mm (by gauge)</p> <p>3mm / >3mm (by gauge)</p> <p>3mm / >3mm (by gauge)</p> <p>3mm / >3mm (by gauge)</p> <p>_____ / _____</p> <p>_____ / _____</p>	P

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	NOTE 2 – If clearances between live parts of the device and the metallic screen or the surface on which the SPD is mounted are dependent on the design of the SPD only and cannot be reduced when the SPD is mounted in the least favourable position (even in a metallic enclosure), the values of lines 1 are sufficient.		P
7.2.5.4	Status indicator		
	The manufacturer shall provide information about the function of the indicator and the actions to be taken after change of status indication.		N/A
	A status indicator may be composed of two parts (one of which is not replaced when e.g. a plug module is changed), linked by a coupling mechanism which can be mechanical, optical, audio, electromagnetic, etc. The part of the status indicator which is not replaced (e.g. base part of socket) shall be capable of operating at least 50 times.		N/A
	Where there is an appropriate standard for the type of indication used, this shall be met by the non-replaced part of the status indicator, with the exception that the indicator need only be tested for 50 operations.		N/A
8.3.3.1	Residual voltage with 8/20 current impulses		
	<p>Class I, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times the crest value of I_{imp} shall be applied.</p> <p>0,1 times I_{imp}</p> <p>0,2 times I_{imp}</p> <p>0,5 times I_{imp}</p> <p>1,0 times I_{imp}</p> <p>Class II, 8/20 current impulses with a sequence of crest values of 0,1; 0,2; 0,5; 1,0 times I_n shall be applied.</p> <p>0,1 times I_n</p> <p>0,2 times I_n</p> <p>0,5 times I_n</p> <p>1,0 times I_n</p> <p>If the SPD contains only voltage-limiting components, this test needs only to be performed at a crest values of I_{imp} for test class I or I_n for test class II.</p>	<p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p> <p>_____ kA / _____ V</p>	N/A
	One sequence of positive polarity and one sequence of negative polarity are applied to the SPD		N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	When I_{max} is declared by the manufacturer an additional 8/20 current impulse with a crest value of I_{max} shall be applied and the polarity that showed higher residual voltages in the previous tests.	_____ kA / _____ V	N/A
	The interval between individual impulses shall be long enough for the sample to cool down to ambient temperature.		N/A
	Current and voltage oscillogram	see Annex 2	N/A
	Crest values – discharge current versus residual voltage diagram to I_n or I_{imp}	see Annex 3	N/A
	The residual voltage used for determining the measured limiting voltage is the highest voltage value corresponding to the range of currents for: <ul style="list-style-type: none"> • class I: up to I_{imp} • class II: up to I_n 	_____ V _____ V	N/A
	The value for determining U_{max} is the highest residual voltage measured at surge currents up to I_n , I_{max} or I_{imp} , as applicable depending on the SPD test class.	_____ V	N/A
7.5.1.2	Overload behaviour		
	If an external maximum overcurrent protection is specified by the manufacturer, the SPD shall be loaded for 1 h with a current equal to 1,6 times the rated current of that maximum overcurrent protection.	$I =$ _____ A	N/A
8.3.5.3	a) Test at the declared short-circuit current rating		
	The test is carried out twice with U_{REF} applied once at (45 ± 5) electrical degrees and once at (90 ± 5) electrical degrees after the zero crossing of the voltage.		N/A
8.3.5.3.2	Additional test for SPD's failure mode simulation		
	For this test any electronic indicator circuitry may be disconnected.		N/A
	New samples shall be used and fitted as in normal use, acc. to the manufacturer's instructions and connected with conductors of the maximum cross section acc. to 8.4.2. The maximum length of the cables connection the sample shall be of 0,5 m each.		N/A
	External disconnectors, if recommended by the manufacturer, shall be used.	_____	N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>The test sample shall be connected to a power frequency voltage source at the following conditioning voltages:</p> <ul style="list-style-type: none"> • SPDs rated U_C up to 440V, apply a voltage equal to $1200 V_{rms}^{+5/-0\%}$ • SPDs with U_C rated above 440V, apply a voltage equal to 3 times $U_C^{+5/-0\%}$ 	_____ V	N/A
	For all types of SPDs with U_C up to 180V, the conditioning voltage may be reduced to 600V if for voltage switching type SPDs and for combination type SPDs, any voltage switching components operate at this voltage.		N/A
	The conditioning voltage is applied for a duration of $5 s^{+5/-0\%}$. The prospective short-circuit current of this power source for conditioning shall be adjusted to a value between 1 A and $20 A_{rms}^{+5/-0\%}$, as provided by the manufacturer according to 7.1.1 d5).	_____ A	N/A
	Following the application of the conditioning voltage equal to $U_{REF}^{+0/-5\%}$ with a short-circuit current capability as given below, shall be applied to the sample for a period of $5 min^{+5/-0\%}$ or for at least 0,5 s after interruption of the current by an internal or external disconnecter.		N/A
	The transition from conditioning voltage application to U_{REF} application shall be performed without interruption. The current flow through the SPD shall be monitored. An appropriate test circuit and timing diagram is shown in Figure 12 and Figure 13.		N/A
	The prospective short-circuit current of the power source at U_{REF} shall have a tolerance of $+5/-0\%$ at the location where the SPD is connected. The power factor of the power source shall comply with Table 8.		N/A
	Each of the following tests shall be performed on a new set of three preconditioned samples as above at U_{REF} with a short-circuit current of 100A, 500A and 1000A, respectively, unless these values exceed the declared short-circuit rating of the SPD.		N/A
	A further test shall be performed on three preconditioned samples as above and at U_{REF} with a prospective short-circuit current equal to the manufacturer's declared short-circuit current rating. For this test, the time interval between the completion of the conditioning test and the application of U_{REF} shall be as short as possible and shall not exceed 100 ms.		N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>If all measurements of the test on the first set of samples (100A test set up):</p> <ul style="list-style-type: none"> • either show a disconnection within 5s during the application of the conditioning voltage <p>or</p> <ul style="list-style-type: none"> • the current through the sample during the application of U_{REF} after conditioning does not exceed a value of 1mA <p>or</p> <ul style="list-style-type: none"> • the current through the sample during the application or U_{REF} after conditioning does not exceed the initial value determined at U_{REF} before the test by more than 20% <p>no further test is performed</p>		N/A
	Pass criteria		
	For this test any damage to electronic indicator circuitry during the conditioning test is not regarded as a failure.		N/A
C	No mechanical damage		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A
M	There shall be no explosion or other hazard to either personnel or the facility		N/A
N	There shall be no flashover to the metallic screen and the 6 A gL/gG fuse connecting the screen shall not operate during the test.		N/A
	<p>Additional pass criteria except for:</p> <ul style="list-style-type: none"> • short circuiting type SPDs • SPDs where the current is interrupted or no significant current flows during the application of U_{REF}. <p>where no disconnection occurs.</p>		N/A
H	Disconnection shall be provided by one or more internal or external disconnectors. Their correct indication shall be checked.		N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
J	<p>If disconnection occurs during the test, there shall be clear evidence of effective disconnection of the corresponding protective component(s).</p> <p>If internal disconnection occurs, the test sample is connected at U_C and rated frequency for 1 min. The current flow shall not exceed a value of 1 mA.</p>	<p>_____ V</p> <p>_____ mA</p>	N/A
	Currents through components connected in parallel to the relevant protective component(s), are disregarded for this measurement.		N/A
	<p>Current through the PE-terminal shall not exceed 1mA</p> <p>If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements.</p>	_____ mA	N/A
7.6.1.3	Vibration and shock (informative)		
	<p>Vibration and shock tests shall be performed according to</p> <ul style="list-style-type: none"> • EN 60068-2-6 for sinusoidal vibration test • EN 60068-2-64 for broadband random vibration test • EN 60068-2-27 for shock test 		N/A
ZB-2.2	Transportation		
	Usually SPDs within their packaging are subjected to mechanical stress due to transportation. This should be checked by a vibration and shock test in accordance with EN 60721-3-2		N/A
ZB.2.3	Special applications		
	<p>Special applications of SPDs may require additional vibration and shock tests, on the device itself.</p> <p>Typical values can be found in EN 60721-3-3 and can be as shown in Table ZB.1.</p>	_____	N/A
	Furthermore other applications like railway may require different parameters that are given in corresponding standards or directly from application. For instance required parameters for railway vibration and shock tests are given in EN 61373.	_____	N/A
	During the sinusoidal and random vibration tests (if requested), the sample should be powered under U_C with a short circuit capability of at least 5A.		N/A
ZB.3	Pass criteria		
C	No mechanical damage		N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
D	Determination of the measured limiting voltage:	$U_P \leq \text{_____ V}$	N/A
	according to 8.3.3.1, but only at a crest value corresponding to I_{imp} for test class I	$\text{_____ kA} / \text{_____ V}$	N/A
	according to 8.3.3.1, but only at I_n for test class II	$\text{_____ kA} / \text{_____ V}$	N/A
	according to 8.3.3.3, but only at U_{OC} for test class III	$\text{_____ kA} / \text{_____ V}$	N/A
	SPDs tested acc. to class I and II containing switching components: Front-of-wave sparkover voltage acc. to 8.3.3.2 All measured peak values (5 pos./5 neg.) below U_P	_____ kV	N/A
E	No excessive leakage currents shall occur after the test		N/A
	If there is more than one possible connection arrangement for normal use, this check shall be performed for all arrangements		N/A
	The SPD shall be connected as for normal use according to the manufacturer's instructions to a power supply at the reference test voltage (U_{REF}). The current that flows through each terminal is measured. Its resistive component (measured at the crest of the sine wave) <ul style="list-style-type: none"> • shall not exceed a value of 1 mA or <ul style="list-style-type: none"> • the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_{REF} = \text{_____ V}$	N/A
	Any resettable or rearmable disconnecter shall be switched off and dielectric withstand shall be checked by application of two times U_C or 1000V a.c. whichever is greater. During the test, no flashover, breakdown of insulation or any other manifestation of disruptive discharge shall occur.	$U_C = \text{_____ V}$ test voltage _____ V	N/A

IEC61643_11B - ATTACHMENT			
Clause	Requirement + Test	Result - Remark	Verdict
	<p>For SPD modes connected N-PE only, the current through the PE-terminal shall be measured, whereas the terminals are connected to a power supply at U_C.</p> <p>Its resistive component (measured at the crest of the sine wave)</p> <ul style="list-style-type: none"> shall not exceed a value of 1 mA <p>or</p> <ul style="list-style-type: none"> the current shall not have changed by more than 20% compared to the initial value determined at the beginning of the test sequence 	$U_C = \text{_____ V}$ $I_{PE} = \text{_____ mA}$	N/A
G	Internal disconnectors shall not operate during the test and shall be in working order after the test.		N/A
I	SPDs having an IP degree \geq IP 2X – no live parts accessible with standardised test finger applied with a force of 5 N, except the ones which are accessible when the SPD is fitted as in normal use.		N/A

TEST REPORT EN 41 003 Particular requirements for equipment to be connected to telecommunication networks and/or a cable distribution system	
Report reference No	70.410.16.104.04-00
Tested by (printed name and signature)	Ying LIU
Approved by (printed name and signature)	Yi ZHU
Date of issue	2016-05-17
Testing Laboratory Name	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
Address	No.88 Hengtong Road, 200070 Shanghai, P.R.China
Testing location	Same as above
Applicant's Name	
Address	
Test specification	
Standard	EN 41003: 2008
Test procedure	TÜV product service regulation
Procedure deviation	N/A
Non-standard test method	N/A
Test Report Form	
Test Report Form No.....	TRF_EN41003_D
TTRF originator	Intertek
Master TTRF	dated 2009-03
Copyright reserved to the Intertek.	
Test item description	Telecom ports integrated in adaptor
Trademark	N/A
Model and/or type reference	N/A
Rating(s) Operating voltage (V).....	250V~ (rated voltage of adaptor)
Rated current (A)	16A (rated current of adaptor)

Particulars: test item vs. test requirements	
Equipment mobility	Movable
Mass of equipment (kg).....	0,13 kg max. (end product)
Protection against ingress of water	IP20
Test case verdicts	
Test case does not apply to the test object	N/A(not applicable)
Test item does meet the requirement ..	P(ass)
Test item does not meet the requirement	F(ail)
Testing	
Date of receipt of test item	2016-04-12
Date(s) of performance of test	2016-04-12 to 2016-05-17
General remarks:	
This report shall not be reproduced except in full without the written approval of the testing laboratory.	
The test results presented in this report relate only to the item(s) tested.	
Relevant safety standard for the application of this standard: EN 60950 / EN 60065 / EN 60335 series / EN 60601-1 / EN 61010-1.	
R = Reference standard EN 60950-1:2006	
"(see remark #)" refers to a remark appended to the report.	
"(see Annex #)" refers to an annex appended to the report.	
Throughout this report a comma is used as the decimal separator.	
Determination of the test result includes consideration of measurement uncertainty from the test equipment and methods.	
Factory information:	

Copy of marking plate and summary of test results:

See marking on label of end product.

Summary of testing result:

We are of the opinion that the product(s) presented in this test report complies (comply) with the standard according to the test results on the submitted samples.

Note:

This test report is common one, which is applicable for all the models with telecom ports RJ11, RJ45 and TV coaxial connectors in adaptor and it shall be read in conjunction with main test report based on DIN VDE 0620-2-1:2013 in conjunction with DIN VDE 0620-1:2013.

EN 41 003			
Cl.	Requirement – Test	Result	Verdict
	GENERAL		—
	Marking and instructions		—
	Rated voltage (V)	250 (for end product)	P
	Symbol of nature of supply	AC	P
	Rated frequency (Hz)	50	P
	Rated current (A) / Rated power (W) (VA)	16A (for end product)	P
	Manufacturer	See page 1	P
	Trademark		N/A
	Type/model		N/A
	Class of equipment	I	P
	Symbol of Class II		N/A
	Certification marks		N/A
4	SAFETY REQUIREMENTS AND COMPLIANCE CRITERIA		—
R4.2.2	Internal enclosures		P
	Test force (N)	10N, 5s	—
R4.2.3	Enclosure located in an OPERATOR ACCESS AREA.....		P
	Test force (N)	30N	—
4.1	Interconnection of equipment		—
R3.5.1	General requirements for interconnection of equipment	TNV	P
4.1.1/ R3.5.2	Types of interconnection circuits	TNV-3 (RJ11), TNV-1 (RJ45, coaxial / TV)	P
4.1.2/ R3.5.3	Interconnection of ELV circuits		N/A
4.1.3	Safety statements	See marking plate for ender product	P
4.2	TNV circuit		—
4.2.1	Limits		P
R2.3.1	Limits of the TNV circuits	TNV-1 and TNV-3	P
R2.3.1a)	TNV-1 circuits	TNV-1 (RJ45, coaxial / TV)	P
R2.3.1b)	TNV-2 and TNV-3 circuits	TNV-3 (RJ11)	P
4.2.2/ R2.3.2	Separation from other circuits and from accessible parts	(see appended tables 1)	P

EN 41 003			
Cl.	Requirement – Test	Result	Verdict
	Voltage (V) in SELV circuits, TNV-1 circuits and accessible conductive parts in event of single insulation fault or component failure.....:	0 V	P
4.2.3/ R2.3.3	Separation from hazardous voltages		P
R2.3.3	Insulation (mm) between TNV circuit and circuit at hazardous voltages	(see appended tables 1)	P
	Method used	Method 2	P
4.2.4/ R2.3.4	Connection of TNV circuits to other circuits		N/A
R2.3.4	Insulation (mm) between TNV circuit supplied conductively from secondary circuit and hazardous voltage circuit..... :	(see appended tables 1)	P
4.2.5/ R2.3.5	Test for operation voltages generated externally		P
R2.3.5	Voltage (V) in SELV circuit, TNV-1 circuit or accessible conductive part	0 V	P
4.3	Protection against contact with TNV circuits		—
4.3.1	Protection in operator access areas		P
4.3.1.1/R2 .1.1.1	Access to energized parts		P
R2.1.1.1	Protection against contact with bare conductive parts of ELV CIRCUITS, HAZARDOUS VOLTAGES and other related energized parts		P
	Test with test finger		P
	Test with test pin		P
	Test with test probe		P
4.3.1.2/R2 .1.1.2	Battery compartments		N/A
R2.1.1.2	The compartment has a door requires a deliberate technique		N/A
	The TNV circuit is not accessible when the door is closed		N/A
	There is a marking next to the door		N/A
4.3.2/R2.1 .2	Protection in service access areas		N/A
R2.1.2	Unintentional contact with bare parts at HAZARDOUS VOLTAGE is unlikely		N/A
4.3.3/R2.1 .3	Protection in restricted access location		N/A
R2.1.3	Except as permitted..... :		N/A

EN 41 003			
Cl.	Requirement – Test	Result	Verdict
4.4	Protection of ETLECOMMUNICATION NETWROK and/or cable distribution network service persons, and users of other equipment connected to the network, from hazards in the equipment		—
4.4.1/R6.1.1	Protection from hazardous voltages		P
4.4.2/R2.6.5.8	Use of protective earthing		P
R2.6.5.8	Protective earthing shall not rely on a TELECOMMUNICATION NETWORK or a CABLE DISTRIBUTION SYSTEM		P
4.4.3/R6.1.2	Separation of the TELECOMMUNICATION NETWORK from earth		P
R6.1.2.1	Insulation between TNV circuit and parts or circuitry that may be earthed	(see appended table 3: electric strength measurements) Leakage current to earth <10mA	P
R6.1.2.2	Exclusions.....:		N/A
4.4.4/R5.1.8	Touch current to TELECOMMUNICATION NETWORKS and CABLE DISTRIBUTION SYSTEM and from TELECOMMUNICATION NETWORKS		P
R5.1.8.1	Limitation of leakage current (mA) to telecommunication network.....:	0mA	P
4.4.5/R5.1.8.2	Summation of touch currents from TELECOMMUNICATION NETWORKS		P
R5.1.8.2	Summation of leakage currents(mA) from telecommunication network.....:	0mA	P
4.5	Protection of equipment users from overvoltages on TELECOMMUNICATION NETWORKS and/or CABLE DISTRIBUTION SYSTEMS		—
R6.2.1	Separation requirements		P
R6.2.2	Electric strength test		P
R6.2.2.1	Impulse tests: separation between TNV-1 circuits/TNV-3 circuits and:		—
R6.2.2.1a)	unearthed conductive parts/non-conductive parts of the equipment expected to be held or touched during normal use; test at 2.5 kV		N/A
R6.2.2.1b)	parts and circuitry that can be touched by test finger except contacts of connectors that cannot be touched by test probe; test at 1.5 kV	(see table 3: electric strength measurements)	P
R6.2.2.1c)	circuitry which is provided for connection of other equipment; test at 1.5 kV		N/A
R6.2.2.3	Compliance criteria		N/A
R6.2.2.2	Electric strength tests: separation between TNV-1 circuits/TNV-3 circuits and:		—

EN 41 003			
Cl.	Requirement – Test	Result	Verdict
R6.2.2.2a)	unearthed conductive parts/non-conductive parts of the equipment wxpected to be held or touched during normal use; test at 1.5 kV		N/A
R6.2.2.2b)	parts and circuitry that can be touched by the test finger except contacts of connectors that cannot be touched by test probe; test at 1.0 kV		N/A
R6.2.2.2c)	circuitry which is provided for connection of other equipment; test at 1.0 kV		N/A
R6.2.2.3	Compliance criteria		P
4.6	Protection of the telecommunication wiring system from overheating		—
R6.3	Output current.....:		N/A

EN 41 003							
1	TABLE: clearance and creepage distance measurements						P
distance through insulation di, clearance cl and creepage distance dcr at/of:	Up (V)	U r.m.s. (V)	di (mm)	required cl (mm)	cl (mm)	required dcr (mm)	dcr (mm)
Between conductive part and TNV-1	60 dc	-	N/A	1,0	>1,3	1,25	>1,3
Between TNV-1/-3 circuit and circuit at hazardous voltage	354	250	N/A	4	>6	5	>6
Between TNV-1 circuit and parts or circuitry that may be earthed	60 dc	-	N/A	1,0	>1,3	1,25	>1,3

2	TABLE: distance through insulation measurements			N/A
distance through insulation di at/of:	U r.m.s. (V)	test voltage (V)	required di (mm)	di (mm)

